CARLSBAD MUNICIPAL WATER DISTRICT

WATER MASTER PLAN UPDATE

Prepared For:

City of Carlsbad
1635 Faraday Avenue
Carlsbad, California 92008

Prepared By:

DUDEK & ASSOCIATES, INC.
605 Third Street
Encinitas, CA 92024
TEL (760) 942-5147

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- Steven Jantz ....Project Manager/Associate Engineer
- William Plummer .... Deputy City Engineer
- Carrie Loya-Smalley .... Senior Civil Engineer
- Kurt Musser.. Public Works Manager
- Terry Smith .... Senior Civil Engineer
- Pat Guevara .... Public Works Manager
- Jim Ball .... Public Works Supervisor
- Mark Biskup .... Associate Engineer
- Casey Arndt .... Engineering Technician
- Joe Adams .... Water System Operations
- Pepper Godfrey .... Accounting Technician

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ANNOTATION

The following abbreviations and acronyms were used in the preparation of this Master Plan:

ACP	asbestos concrete pipe
ADD	average day demand
AF	Acre-feet
APN	assessor parcel number
CCI	construction cost index
cfs	cubic feet per second
CIP	capital improvement program
CMLC	Concrete mortar lined and coated
CMWD	Carlsbad Municipal Water District
CWA	County Water Authority [San Diego]
DBP	disinfection by-products
diam.	Diameter
DIP	ductile iron pipe
DOHS	Department of Health Services [California]
EDU	equivalent dwelling unit
EIR	Environmental Impact Report
FCV	Flow control valve
fps	feet per second
GIS	Geographical Information System
gpd	gallons per day
gpm	gallons per minute
HCF	hundred cubic feet
HGL	hydraulic grade line
Hp	Horsepower
hr	Hour
HWL	high water level

lf	linear feet
LFMZ	Local Facility Management Zone
in	Inches
MCL	Maximum contaminant level
MDD	maximum day demand
MFDU	multi-family dwelling unit
MG	million gallons
mgd	million gallons per day
MRDL	Maximum residual disinfectant level
OMWD	Olivenhain Municipal Water District
PF	peaking factor
PRS	Pressure reducing station
PRV	pressure reducing valve
psi	pounds per square inch
PSV	pressure sustaining valve
SanGIS	San Diego County Geographic Information System
SDCWA	San Diego County Water Authority
SDWD	San Dieguito Water District
SFDU	single family dwelling unit
sqft	square feet
TAP	Tri-Agency Pipeline
TTHM	total trihalomethanes
USGS	United States Geologic Survey
VCP	vitrified clay pipe
VFD	variable frequency drive
VID	Vista Irrigation District
VWD	Vallecitos Water District
WRP	Water Reclamation Plant
yr	Year

CHAPTER 1
INTRODUCTION

This Water Master Plan Update for the Carlsbad Municipal Water District (CMWD) evaluates the existing water distribution system and its ability to meet projected demands. The most recent update to the Water Master Plan was performed in 1997. Since the last Master Plan Update, a significant number of residential, commercial and industrial developments have been constructed and future development has been identified in the City's 2001 Growth Database. This current Master Plan presents an update of the District's Water Master Plan for the planning period between 2001 and build-out of the District's service area, which is anticipated to occur by 2020.

1.1 BACKGROUND

The first water supply to the Carlsbad area was obtained from the San Luis Rey River, in the City of Oceanside. Wells were drilled in 1886 by the Carlsbad Land and Water Company, and a pipeline was constructed to transport the groundwater to Carlsbad. The wells continued to be the only supply for many years. By the 1930's, summer demands exceeded the capacity of the wells. Lake Calavera was constructed in 1936 to store excess well water in the winter for later use in the summer months. However, the quantity and quality of the ground water gradually degraded, resulting in the need for a new supply source to meet the area's growing water demand.

The Carlsbad Municipal Water District (CMWD) was formed in 1954 to bring imported Colorado River water into the area. In 1990, the CMWD became a subsidiary district of the City of Carlsbad, with the Mayor and City Council acting as the CMWD's board. Operating under the Municipal Water District Act of 1911, the CMWD supplies both potable and recycled water. The CMWD currently purchases 100% of its water for the potable water system as treated water from the San Diego County Water Authority (CWA). Water is supplied through the San Diego County Water Authority (SDCWA) aqueduct and the Tri-Agency Pipeline (TAP). The population currently served is estimated at approximately 72,000.

1.2 SERVICE AREA OVERVIEW

The CMWD water service area covers approximately 85 percent of the City of Carlsbad and includes an area of about 32 square miles. Water service to the southeast corner of the City is provided by the Olivenhain Municipal Water District (OMWD). The Vallecitos Water District (VWD) provides service to the Meadowlark area along the eastern City limit. The CMWD service area boundary and adjacent district boundaries are shown on Figure 1-1.

The elevation of the CMWD service area varies from just under 700 feet at the eastern boundary to sea level along the coast and lagoon shores. Water is supplied from four CWA aqueduct connections and transported in separate transmission mains to four locations along the eastern City boundary. Within the CMWD service area, water is generally supplied by gravity from east to west. The service area is comprised of seventeen pressure zones, which extend from approximately the eastern service area boundary and decrease in pressure west to the coast.

1.3 PREVIOUS MASTER PLANS

A summary of the two most recent Water Master Plans is provided in the sub-sections below.

1.3.1 1990 Water Master Plan

The 1990 Water Master Plan was prepared by MacDonald-Stephens Engineers, Inc. and adopted by the Carlsbad City Council on January 29, 1991. In 1990, the existing average day demand was 14.6 MGD. Flow projections were made based on the City of Carlsbad 1988 General Plan, and the ultimate average day demand was projected to be 24.5 MGD. Reservoir "daily" and "emergency" storage criteria were established in this Master Plan.

1.3.2 1997 Water Master Plan Update

The 1997 Water Master Plan Update was prepared by ASL Consulting Engineers and submitted as Volume III of the overall 1997 Master Plan Update. The purpose of this update was to incorporate revised population projections to build-out of the City based on the 1994 General Plan and specific project development plans. The 1997 Master Plan Update also incorporated a decrease in the average per capita water consumption of approximately 15 percent from the last Master Plan, and the installation of the 8.5MG Twin "D" reservoir. The ultimate average day demand was projected to be 25.4 MGD, which included 1.34 MGD (1,500 AF per year) of recycled water demands.

As part of the 1997 Master Plan Update, a separate investigation was made into using potential local water resources, in addition to imported water, to increase the reliability of the water supply. The results of this study were submitted as Volume II, Water Resources Potential. In 2000, an update was made to the 1997 Master Plan water hydraulic model to reflect additions to the water distribution system.

1.4 2003 UPDATE SCOPE AND PURPOSE

Since the last Master Plan Update a significant number of residential, commercial and industrial developments have been both constructed and planned for future construction. The Carlsbad Municipal Water District, in its Notice to Proceed dated December 24, 2001, retained Dudek & Associates, Inc. to provide engineering services necessary to analyze and evaluate existing and future requirements for continued reliable potable water service. The purpose of the Master Plan Update is to confirm transmission main sizing, identify deficiencies in the system, and identify future capital improvement projects based on updated ultimate demand projections.

In summary, the scope of work includes tasks to document and analyze existing facilities, develop unit water demands and peaking factors, project ultimate water demands, and recommend facility and operational improvements based on hydraulic analyses results. In this Master Plan Update ultimate water demand projections are based on planned developments included in the City's recently compiled 2001 Growth Database. The Growth Database projects the number of additional single and multi-family units and the number and size of non-residential buildings at buildout. At the direction of City staff, projected Phase II recycled water demands are included in the ultimate potable water demand projections. To analyze the water distribution system, the City's 2001 H_2ONET computer model was updated and enhanced to perform hydraulic analyses on the existing and ultimate water systems. The outcome of the analyses is a recommended long-term capital improvement program (CIP) that will provide a water distribution system capable of supplying the CMWD at build-out conditions.

CHAPTER 2
EXECUTIVE SUMMARY

The Carlsbad Municipal Water District (CMWD) Water Master Plan Update documents the existing water system facilities and demands, and identifies required improvements for build-out of the District's service area, which is anticipated to occur by 2020. The water system analyses conducted as a part of this project and documented in this report were performed to identify existing deficiencies in the system, confirm facility sizing, and recommend a future capital improvement program (CIP) based on updated ultimate demand projections.

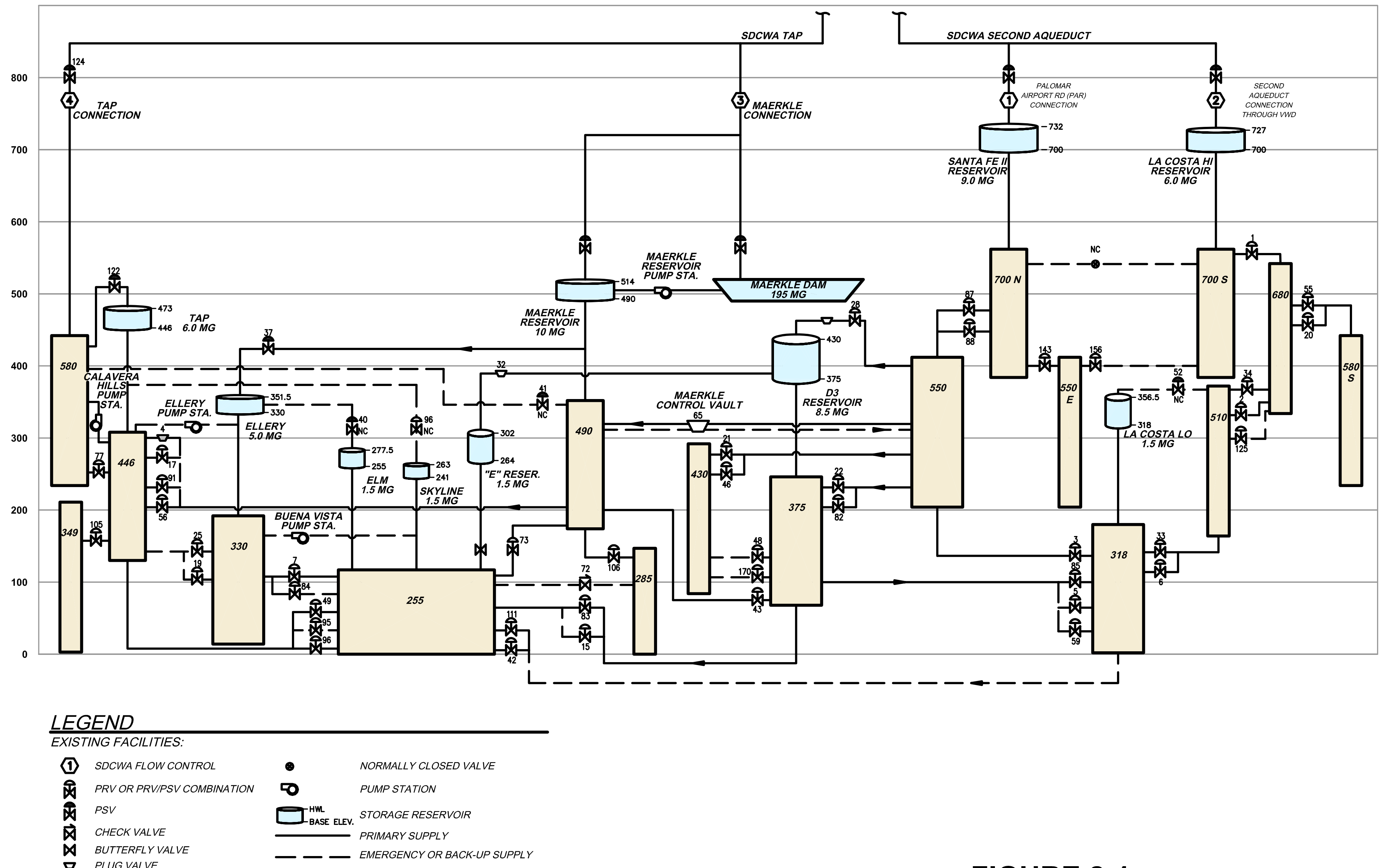
2.1 INTRODUCTION

This Water Master Plan Update for the Carlsbad Municipal Water District (CMWD) evaluates the existing water distribution system and its ability to meet projected demands. The CMWD water service area covers approximately 85 percent of the City of Carlsbad and includes an area of about 32 square miles. Water service to the southeast corner of the City is provided by the Olivenhain Municipal Water District (OMWD). The Vallecitos Water District (VWD) provides service to the Meadowlark area along the eastern City limit.

The most recent update to the Water Master Plan was performed in 1997. Since that time, a significant number of residential, commercial and industrial developments have been both constructed and planned for future construction. In this current Water Master Plan Update, ultimate water demand projections are based on planned developments included in the City's recently compiled 2001 Growth Database. The Growth Database projects the number of additional single and multi-family units and the number and size of non-residential buildings at buildout. At the direction of City staff, irrigation demands are included in the ultimate potable water system under the conservative assumption that the planned Phase II Recycled Water System is not constructed.

2.2 EXISTING FACILITIES SUMMARY

For purposes of this Master Plan Update, the existing water system consists of facilities that were operational as of December 2001. The facilities comprising the existing CMWD distribution system include San Diego County Water Authority (SDCWA) turnouts, transmission mains, distribution pipelines, pressure reducing stations, storage reservoirs, pump stations, and inter-ties with adjacent water agencies. The existing water distribution system is shown schematically on Figure 2-1 and illustrated on the color wall map provided as Exhibit 1 in Appendix A.



NOTE:

VALVE ID NUMBERS CORRESPOND TO ID NUMBERS IN THE CONTROL VALVE SUMMARY TABLES.

FIGURE 2-1

CARLSBAD MUNICIPAL WATER DISTRICT
EXISTING SYSTEM HYDRAULIC PROFILE

DUDEK & ASSOCIATES, INC.

The CMWD imports water through the SDCWA for their potable water needs. Water is supplied to the CMWD through four separate SDCWA treated water turnouts. Two of the turnouts, CWA No. 1 and CWA No. 2, are direct connections to the SDCWA Second Aqueduct. CWA No. 1 supplies only the CMWD, and CWA No. 2 supplies the Vallecitos Water District (VWD) and the Olivenhain Municipal Water District (OMWD) in addition to the CMWD. Water supply to the CMWD from CWA No. 2 is delivered through a VWD transmission main. Connections No. 3 and No. 4 to the aqueduct system are on the SDCWA owned and operated Tri-Agency Pipeline (TAP), which is also supplied from the SDCWA Second Aqueduct. The TAP also serves the City of Oceanside and the Vista Irrigation District (VID).

The existing distribution system consists of 17 major pressure zones, which are supplied by gravity from over 50 pressure regulating stations. There are three pump stations within the distribution system that are used for emergency purposes only. The CMWD water distribution system is flexible in that supply from the four aqueduct connections can be routed to different parts of the distribution system by making changes to several key valve settings. This allows system operators to balance reservoir levels and correct for discrepancies in the amount of water ordered versus the amount that is delivered through service connections.

Water storage for the CMWD is provided by Maerkle Dam and 12 additional reservoirs within the distribution system. Maerkle Dam is the major treated water storage facility for the CMWD, with a capacity of approximately 600 acre-feet (195 MG). This reservoir is used to meet the City's requirement to provide a minimum of ten days of emergency drinking water storage. Under normal operations, water is supplied to Maerkle Dam from the SDCWA TAP No. 3 connection and then pumped into the adjacent Maerkle Reservoir. From Maerkle Reservoir water is supplied by gravity to the distribution system. Currently the high pressure zones in the southeast portion of the service area (700, 680, 580S and 510) cannot be supplied with emergency water from the dam.

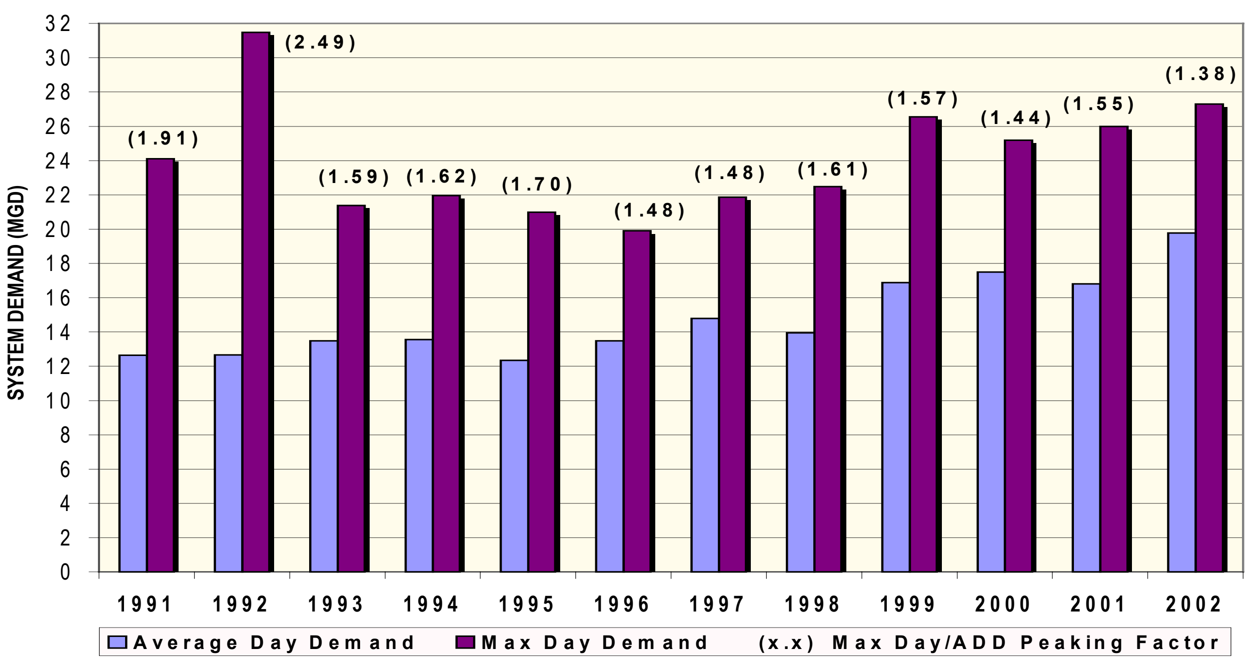
Water storage for fire flow and daily water operations is provided by eleven reservoirs (enclosed storage tanks) within the distribution system. The existing operational storage capacity is 51.5 MG, excluding Maerkle Dam. Table 3-3 provides a summary of the storage facilities, including a small reservoir used as a forebay for the Buena Vista Pump Station. All water storage is above ground except for the Maerkle Dam and Maerkle Reservoir. The distribution system reservoirs have been designed to be extremely flexible in their ability to transfer water throughout the District.

During planned shutdowns of the SDCWA aqueduct, which are normally scheduled for up to 10 days during the winter, most of the CMWD is supplied from Maerkle Dam through the 490 Zone Maerkle Reservoir. The 700, 680, 580N and 510 Zones are currently supplied from the 700 Zone reservoirs (Santa Fe II and La Costa Hi) and an inter-tie with the VID. A potable pump must be installed at the VID/CMWD inter-tie to boost pressures to the CMWD 700 Zone.

2.3 EXISTING WATER DEMANDS

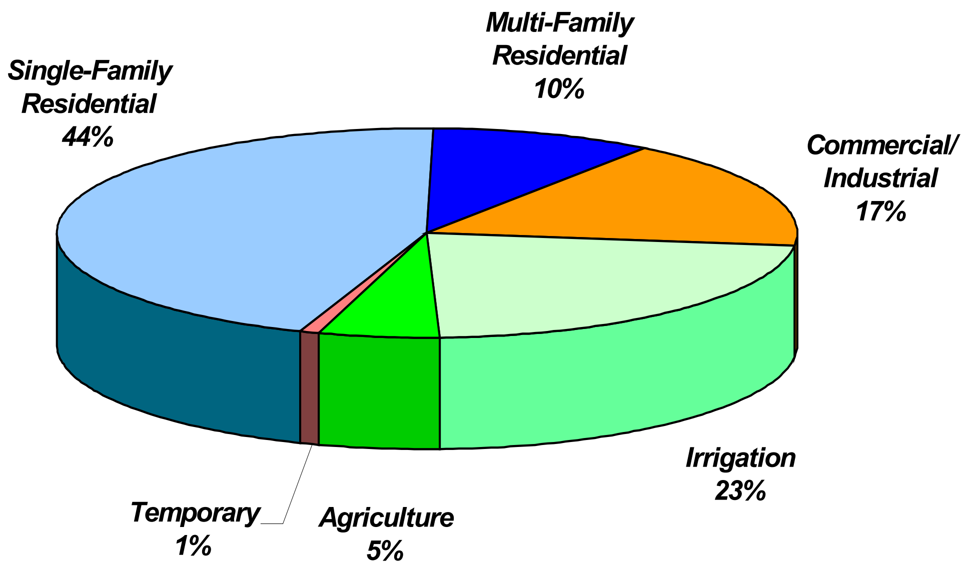
As population expands and the northern coastal areas of San Diego County continue to develop, the CMWD has experienced gradually increasing water demands. Historical water consumption over the past ten years based on SDCWA water purchase records and the gain/loss of stored water in Maerkle Dam is graphically illustrated on Figure 2-2. CMWD monthly water billing records for 2001 were obtained and analyzed to establish the existing water demands and distribute water demands in the distribution system hydraulic model. The total average rate of water supplied for 2001 based on CMWD billing records is 16.2 MGD and the average rate purchased is 16.8 MGD. The amount of water billed does not match the volume of water purchased due to "unaccounted for" water. In most water distribution systems, the bulk of "unaccounted for" water is due to system leakage, meter inaccuracies, and unmetered water consumption from fire fighting, street cleaning, and construction uses. Water loss in the CMWD over the past ten years has typically been between two and five percent.

Figure 2-2
CMWD HISTORICAL DEMAND BASED ON SDCWA PURCHASES



The percentage of the total system demand based on water use categories is illustrated on Figure 2-3. Residential water use accounts for 54 percent of the total water demand. Commercial/Industrial water use and irrigation demands make up 17 and 23 percent, respectively, of the total water demand. It is noted that the irrigation demands do not include users supplied from the CMWD Recycled Water System, as recycled water users are identified with separate recycled water account types. However, supplemental potable water is supplied to the recycled water system during peak demand periods at the "D" Tanks. Agricultural water demands currently account for approximately five percent of the total water use.

Figure 2-3
2001 WATER DEMAND BY CATEGORY



Water demands are typically presented in terms of the average annual water consumption. Actual water use, however, follows a widely varying pattern in which flows are sometimes well below or far greater than "average". Flow variations are commonly expressed in terms of peaking factors, which are multipliers to express the magnitude of variation from the average day demand (ADD). Peaking factors are commonly used to express the system maximum and minimum month demand, the maximum day demand (MDD), and the peak hour demand. The 2001 system demands are summarized in Table 2-1 and described in detail in the following sub-sections.

Table 2-1
SUMMARY OF 2001 SYSTEM DEMANDS

Average Day	16.2 MGD	25.1 CFS
Minimum Month	8.0 MGD	12.4 CFS
Maximum Month	23.0 MGD	35.6 CFS
Maximum Day	26.5 MGD	41.0 CFS
Peak Hour	46.6 MGD	72.1 CFS

2.4 EXISTING SYSTEM EVALUATION

Hydraulic computer simulations were performed to evaluate the existing water distribution system based on comparisons with established and verified planning criteria. The hydraulic analysis employs the use of the H_2ONet® hydraulic modeling software. The planning criteria, analysis methodology, hydraulic computer model and results of the hydraulic system analyses used in the evaluation of the water distribution system relative to 2001 conditions are summarized in the sub-sections below.

2.4.1 Planning Criteria

The planning criteria for the evaluation of potable water facilities in the CMWD are based on existing system performance characteristics, past criteria used by the District and current industry and area standards. Planning criteria include standards for demand peaking factors, pressure zones, pipelines, fire flows, and storage reservoirs. A summary of criteria that impact the design of water facilities is provided in Table 2-2. These criteria are the basis for evaluating water system performance and determining facilities required to serve future development.

Table 2-2
CMWD PLANNING AND PERFORMANCE CRITERIA SUMMARY

WATER DEMAND PEAKING FACTORS	0.5 x ADD – Minimum Month Demand 1.5 x ADD – Maximum Month Demand 1.65 x ADD – Maximum Day Demand 2.9 x ADD – Peak Hour Demand
SYSTEM PRESSURES	Static Pressures (based on the reservoir HWL): 60 psi – minimum desired 125 psi – maximum desired 150 psi – maximum allowed Dynamic Pressures (with reservoir levels half full): 40 psi – minimum allowable pressure during peak hour demands 20 psi – minimum allowable pressure for fire flows 25 psi -–maximum desired pressure drop from static pressures
PIPELINES	8 fps – maximum allowable velocity at peak hour flow 5 ft./1000 ft – maximum desirable head loss at peak flow 10 ft./1000 ft – maximum allowable head loss at peak flow Dead-end water lines are to serve no more than 18 residences
FIRE FLOWS	Single-Family residential – 1,500 gpm for 2 hours Multi-Family residential – 3,000 gpm for 2 hours Industrial/Commercial/Institutional – 4,000 gpm for 4 hours

Table 2-2 *(continued)*

DAILY STORAGE	Storage capacity in the distribution system equal to the <u>total</u> of the following based on the reservoir service area: Operational – 15% of Maximum Day Demand Reserve – 100% of the Maximum May Demand Fire Flow – Maximum fire flow for the required duration
EMERGENCY STORAGE	10 days of storage based on the ADD *Emergency storage is contained in the Maerkle Dam*

2.4.2 Hydraulic Model Development

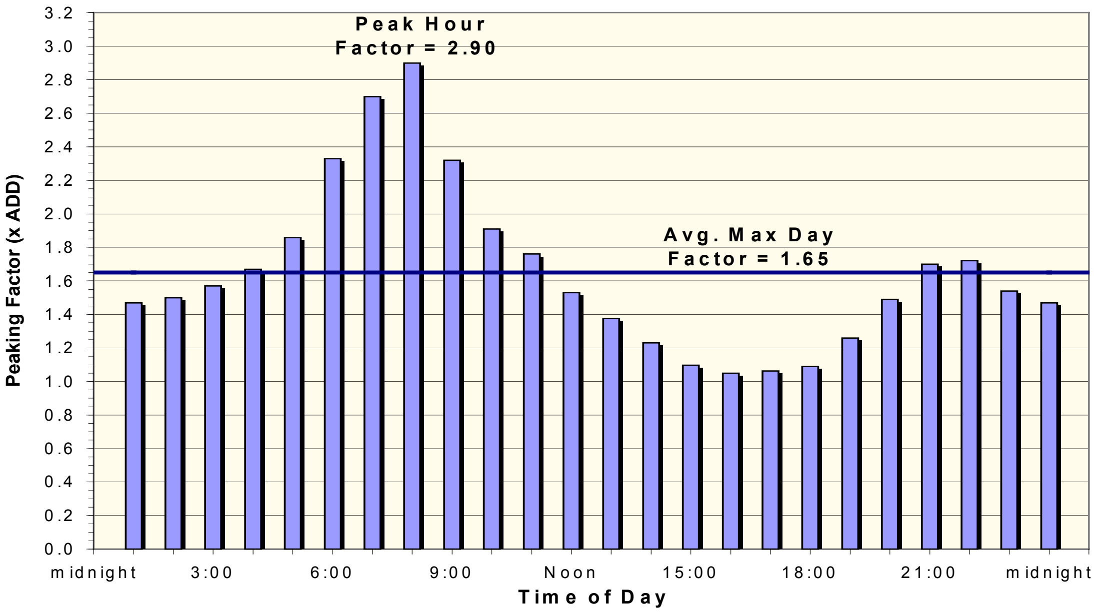
Analysis of the water distribution system is performed using the H_2ONET® modeling, analysis and design software developed by MWH Soft, Inc. H_2ONET® provides a computer aided design (CAD) interface for building and editing model facilities, and a hydraulic analysis engine to perform extended period simulations. An H_2ONET® hydraulic computer model was developed for the CMWD in 1997 as part of the 1997 Water Master Plan Update. This model was calibrated to 1997 conditions. In 1999, the model was updated with pipelines for developments between 1997 and 1999. For this current Master Plan Update, the 1999 model has been updated and enhanced to represent the 2001 water distribution system. New demands were input to the existing system model based on 2001 water billing records. The process of importing the billing data was performed using GIS techniques.

2.4.3 Maximum Day Demand 24-Hour Simulation

To assess performance of the existing distribution system, system demands corresponding to a maximum demand day were developed and input to the existing system model. The representative 24-hour maximum day peaking curve for the CMWD, based on the flow analysis of two high demand days in 2001, is shown on Figure 2-4. Based on this representative curve and an existing system ADD of 16.2 MGD, the maximum day 24-hour demand analyzed is 26.7 MGD, and the peak hour demand is 47.0 MGD.

An extended period simulation was run to assess overall system performance and reservoir operations (the ability to supply peak flows and refill after draining). Several simulation iterations were required to properly adjust the SDCWA inflows and distribution system valves with variable settings. After the final flow adjustments were made, reservoir levels were maintained between 25-75 percent full during the 24-hour simulation with maximum day demands.

Figure 2-4
MAXIMUM DAY DEMAND PEAKING FACTOR CURVE



Results of the 24-hour simulation were reviewed and analyzed. Low pressures were observed in the 680 Zone on Obelisco Court and near the 330 Zone in the vicinity of the Elm Reservoir. The low pressures are a result of high elevations, and are not due to undersized facilities. High pressures were observed in the 490 Zone transmission main in El Camino Real near Jackspar (175-185psi) and along an 8-inch diameter pipeline in Paseo Cerro (140-160psi), located between Melrose Drive and the CMWD boundary in the 700N Zone. In summary, analysis results indicate that the existing distribution system has adequate capacity to supply peak summer demands. In the model simulation, flows entering the system and flow adjustments to reservoirs were balanced by trial-and-error. In actual operations the flow entering the system does not typically match the demand, and several flow adjustments are usually required by system operators to balance reservoir levels.

2.4.4 Fire Flow Analysis

A fire flow analysis was performed on the existing system hydraulic model to determine the fire flow capacity at each demand node. The fire flow simulation was run with maximum day demands (ADD x 1.65) and the water level at reservoirs set to half full. The available fire flow was compared to the required fire flow based on the meter account type (1,500 gpm for single-family, 3,000 gpm for multi-family, or 4,000 gpm for commercial/industrial). Analysis results indicated that seven nodes could not provide a residential fire flow of 1,500 gpm at a minimum pressure of 20 psi. Four nodes could not provide the required multi-family fire flow of 3,000 gpm, and three demand nodes could not provide a commercial/industrial fire flow of 4,000 gpm with a minimum 20 psi residual pressure. Pipeline improvements will be required to deliver the required fire flow at these locations.

2.4.5 Storage Analysis

The required storage volume based on the criteria defined in Table 2-2 and 2001 demands was calculated and compared to the capacity of the existing system reservoirs. Calculations to determine the required daily storage volume are shown in Table 2-3. Based on these calculations, there is approximately 12.5 million gallons (MG) of excess storage capacity in the existing system. However, on a zone-by-zone basis the 318 and 255 Zones are currently deficient in storage.

Table 2-3
EXISTING DAILY STORAGE REQUIREMENTS

RESERVOIR	Service Zones	Existing Demand		Storage Requirements				Reservoir Capacity	Surplus/ Deficit
		ADD (MGD)	MDD (MGD)	Operational (.15 x MDD)	Fire Flow[1]	Reserve (1 MDD)	Total		
La Costa High	700S 680 580S 510	0.04 0.41 0.07 0.20	0.07 0.68 0.12 0.33	0.2 MG	0.96 MG	1.2 MG	2.3 MG	6.0 MG	3.7 MG
Santa Fe II	700N 550 430	0.72 2.47 0.17	1.19 4.08 0.28	0.8 MG	0.96 MG	5.5 MG	7.3 MG	9.0 MG	1.7 MG
Maerkle Res.	490 285 198	0.02 0.16 0.08	0.03 0.26 0.14	0.1 MG	0.96 MG	0.4 MG	1.5 MG	10.0 MG	8.5 MG
TAP	580[2] 446 349	0.41 1.65 0.08	0.68 2.72 0.13	0.5 MG	0.96 MG	3.5 MG	5.0 MG	6.0 MG	2.5 MG
D3	375	1.91	3.15	0.5 MG	1.92 MG	3.2 MG	5.5 MG	8.5 MG	3.0 MG
La Costa Lo	318	3.00	4.95	0.7 MG	0.96 MG	5.0 MG	6.7 MG	1.5 MG	-5.2 MG
Ellery	330	1.15	1.90	0.3 MG	0.96 MG	1.9 MG	3.1 MG	5.0 MG	1.9 MG
Elm Skyline "E" Res.	255	3.70	6.11	0.9 MG	0.96 MG	6.1 MG	8.0 MG	4.5 MG	-3.5 MG
TOTALS		**16.2**	**26.8**	**4.0 MG**	**8.6 MG**	**26.8 MG**	**39.5 MG**	**50.5 MG**	**12.5 MG**

(1) Equal to the volume of water based on the largest fire flow within the tank service area (flow rate times duration). For large service areas, the fire flow storage was increased based on the potential for multiple fires.
(2) The 580 Zone has no available storage but can be supplied from the TAP Res. through the Calavera Pump Station.

The CMWD emergency storage policy is to provide 10 days of average water use. Based on the existing ADD of 16.2 MGD, the required storaege volume is 162 MG. Maerkel Dam, which has a storage capacity of 195 MG, currently provides the required storage volume for the District.

2.5 ULTIMATE DEMAND PROJECTIONS AND ANALYSIS

The CMWD ultimate demand is projected based on existing demands, future water demands calculated from the Growth Database, and future irrigation demands obtained from recycled water projections. A hydraulic analysis is performed with projected ultimate maximum day demands to verify and size the future facilities, and to identify any additional facilities required to serve the CMWD at buildout.

2.5.1 Carlsbad Growth Database

Build-out projections for the City of Carlsbad have been recently updated and compiled into a Growth Database, which is maintained by the City. Most of the projected growth in the CMWD is associated with known, planned developments in the eastern portion of the City. The remainder of the future growth in the City of Carlsbad includes smaller developments and "infill" of established neighborhoods and commercial areas, generally located in the western portions of the City. The growth potential data in the Carlsbad Growth Database used for this Master Plan Update is summarized by Local Facility Management Zone (LFMZ) in Table 2-4.

Table 2-4

CITY OF CARLSBAD GROWTH DATABASE SUMMARY

LFMZ	No. of Res. Units		Non-Residential	Comments
No.	SFDU	MFDU	Bldg Area (sqft)	
1	430	0	0	Downtown area; Unit counts from 5/15/02 LFMZ 1 update
2	25	146	39,656	3 second dwelling units counted as MFU
3	13	0	193,251	
4	0	0	50,000	
5	0	0	4,137,974	Includes Faraday Business Park and airport
6	185	0	89,988	Future church assumed at 9,100 sqft (25% coverage)
7	345	436	32,670	Calavera unit counts from 7/15/02 update; Future elem.school
8	186	544	6,000	Kelly Ranch
9	41	0	428,100	
10	750	320	0	Villages of La Costa; Future elementary school
11	1,266	275	622,972	Villages of La Costa
12	55	0	20,000	Future church assumed at 20,000 sqft
13	0	18	1,482,142	24 room hotel expansion assumed at 1 hotel unit =.75 MFDU
14	711	411	229,166	Unit counts from Robertson Ranch update; Future High School
15	807	158	303,798	Sycamore Creek; 8 second dwelling units counted as MFDU
16	0	0	1,921,000	Carlsbad Oaks North BP; Building area from 8/01/02 update
17	523	100	2,511,000	Bressi Ranch; 40,000 sqft for private school & daycare/church
18	308	0	2,262,817	140 condos counted as SFDU
19	218	78	69,520	61 condos counted as SFU; 78 timeshares counted as MFDU
20	687	24	73,450	
21	185	210	0	
22	168	286	53,280	149 condos counted as SFU
23	0	264	507,000	includes assisted living project (non-res & MFDUs)
24	32	0	0	
25	130	0	0	
Totals	**7,065**	**3,270**	**15,033,784**	

Note: shaded rows indicate LFMZs with parcels outside of the CMWD

The unit demands developed to project ultimate water demands from buildout data in the Growth Database are listed in Table 2-5. These water demands were reviewed and approved by CMWD Staff.

Table 2-5
UNIT DEMANDS FOR ULTIMATE PROJECTIONS

LAND USE TYPE	PROJECTED WATER USE FACTOR	DEVELOPMENT UNIT
Single-Family Residential	550 gallons per day	per dwelling unit
Multi-Family Residential	250 gallons per day	per dwelling unit
Non-Residential	2,300 gallons per day	per 10,000 square feet of building area

2.5.2 Ultimate Demand Projections

Ultimate demand projections are based on build-out conditions for the CMWD, which is projected to occur by the year 2020. The CMWD is surrounded by four neighboring districts, and there is no expectation of altering the current district boundary in the future The projected ultimate demand under various peaking conditions is listed in Table 2-6.

Table 2-6
SUMMARY OF PROJECTED ULTIMATE DEMANDS

Average Day	23.9 MGD	37.0 CFS
Minimum Month	12.0 MGD	18.5 CFS
Maximum Month	35.9 MGD	55.5 CFS
Maximum Day	39.4 MGD	61.0 CFS
Peak Hour	69.3 MGD	107.2 CFS

The scope of work for this Master Plan Update states that "ultimate demand projections are to be based on the assumption that the planned Phase II expansion of the CMWD Recycled Water System is <u>not</u> constructed". To estimate ultimate demands, demand projections for future development identified in the Growth Database and irrigation demands identified from the 1999 Recycled Water Master Plan are added to existing system demands. The projected ultimate demand is illustrated together with historical demands on Figure 2-5. An estimate of the ultimate water use by category is provided in Figure 2-6.

Figure 2-5
HISTORICAL DEMANDS AND ULTIMATE DEMAND PROJECTIONS

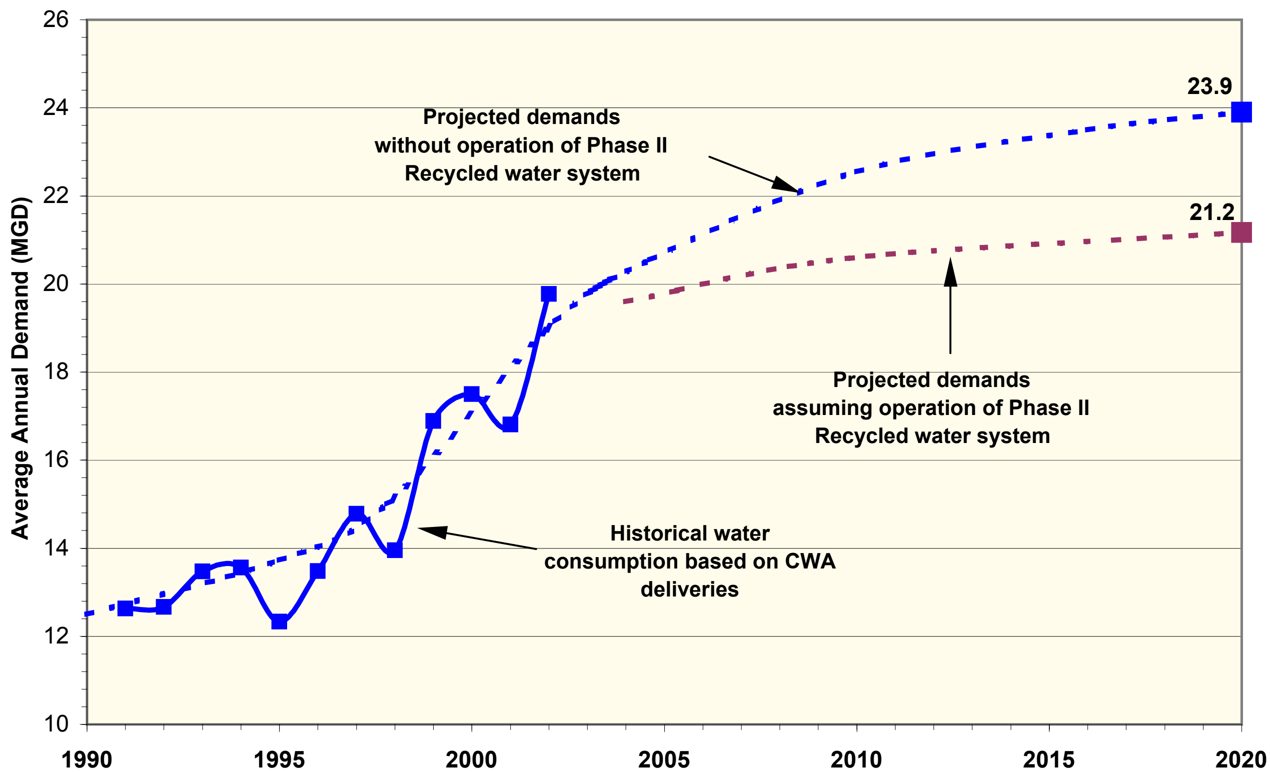
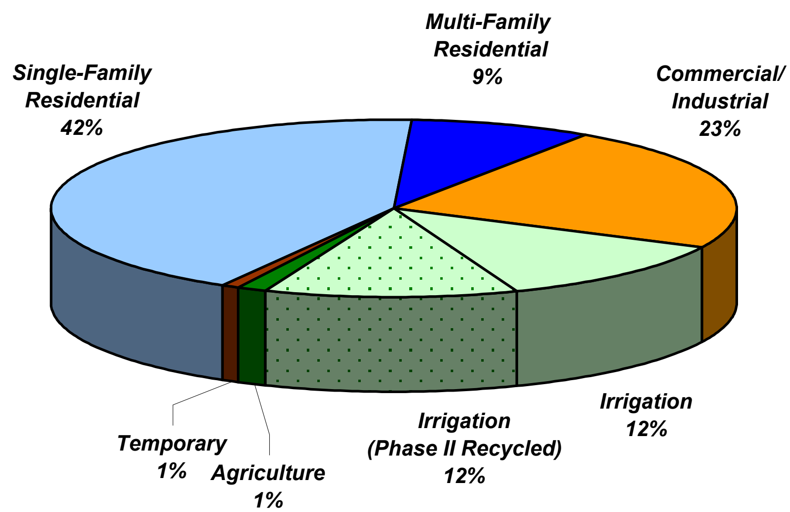


Figure 2-6
PROJECTED ULTIMATE DEMANDS BY CATEGORY



2.5.3 Ultimate System Hydraulic Analysis

The ultimate system H_2ONET® model was developed from the existing system model, layout plans for planned developments, and current CMWD CIP projects. The hydraulic profile of the ultimate system as modeled is provided in Figure 2-7. The ultimate system model includes only the existing storage facilities, however additional storage facilities are recommended to satisfy the required storage criteria (discussed in the next section). A new pump station was added to the model to supply the 700 Zone from the 490/550 Zone under the emergency supply scenario from Maerkle Dam.

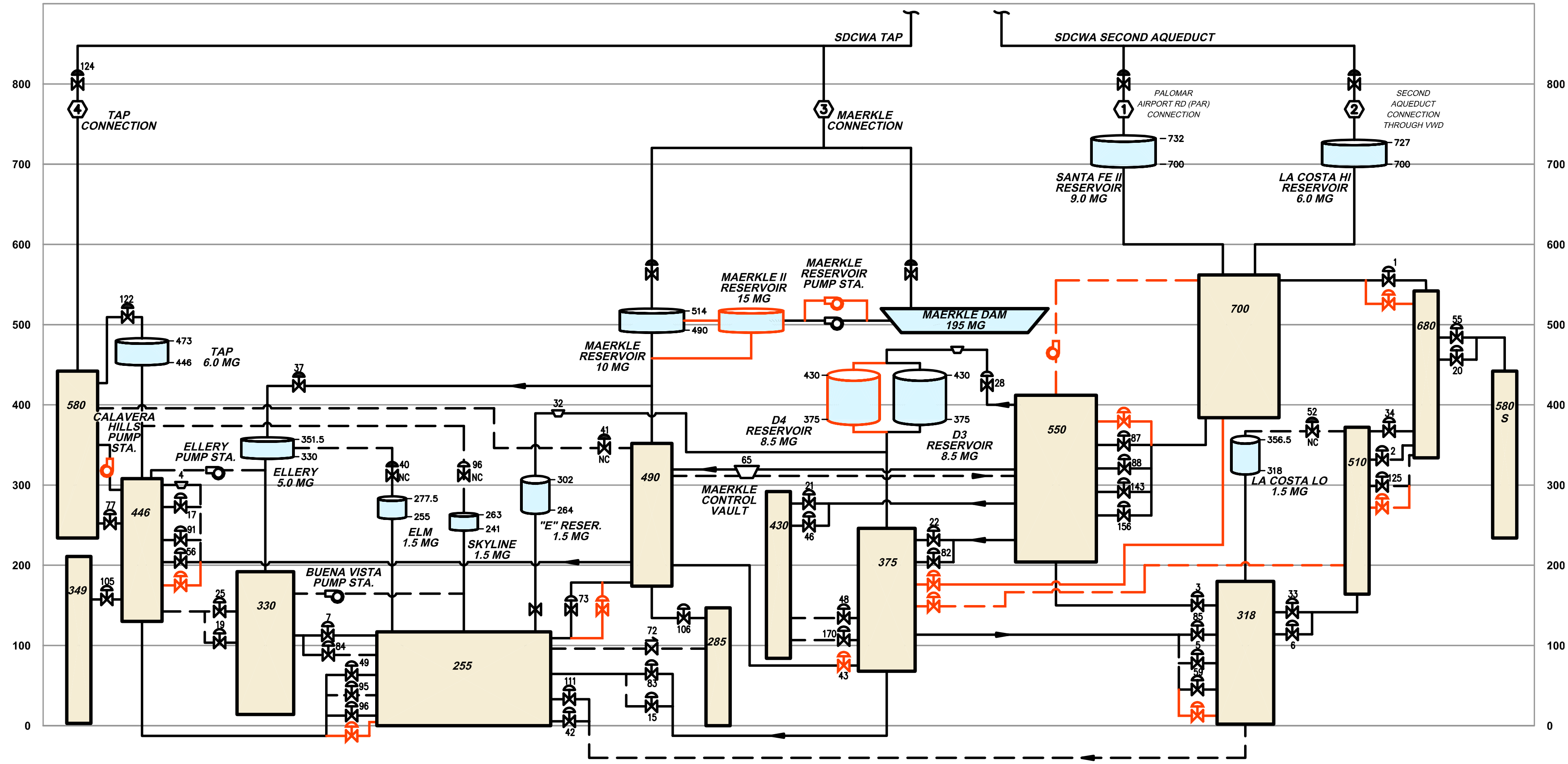
Projected demands were input to the ultimate system model using a multi-step process. Hydraulic analysis of the ultimate system was performed to size and verify proposed future facilities. The ultimate system model was analyzed under both maximum day demand and emergency supply scenarios. Several iterations of the ultimate system model were developed as proposed facilities were added or modified based on analysis results. The final ultimate system model is illustrated on Exhibit 2 in Appendix A

Maximum Day Demand 24-Hour Simulation - Projected demands corresponding to an ultimate system maximum demand day were developed and input to the ultimate system model to identify and size future facilities. Several simulation iterations were required to properly adjust the SDCWA inflows, distribution system valves with variable settings, and pressure settings for new pressure reducing valves.. The final SDCWA inflows modeled at the aqueduct connections are shown in Table 2-7. Supply from SDCWA Connection No. 3 (Supply to Maerkle Reservoir/Dam) was maximized based on the increased transmission capacity of the 490 Zone and the benefit of increased circulation in Maerkle Dam. It is noted that the supply from SDCWA Connection No. 2 is at the existing rated capacity, and the supply from the Maerkle Connection is nearly at capacity.

Table 2-7
SDCWA MAX DAY SUPPLY IN THE ULTIMATE SYSTEM MODEL

San Diego County Water Authority Connection	Rated Capacity*		Supply in Ultimate System Mode with Max Day Demands	
	(MGD)	(cfs)	(MGD)	(cfs)
CWA No. 1 (Palomar Airport Road Connection)	23.3	36.0	16.2	25.0
CWA No. 2	8.6	13.3	8.6	13.3
TAP No. 3 (Maerkle Connection)	11.6	18.0	11.0	17.1
TAP No. 4 (TAP Connection)	8.7	13.5	5.1	7.8
TOTALS	**52.2**	**80.8**	**40.9**	**63.3**

* Rated capacity for Conn. No. 1, 3 and 4 is the capacity of the SDCWA meter at the turnout, minus 10%.
Rated capacity for Conn. No. 2 is based on a contractual agreement with VWD, OMWD, and Carlsbad.



LEGEND

EXISTING FACILITIES:

- SDCWA FLOW CONTROL
- PRV OR PRV/PSV COMBINATION
- PSV
- CHECK VALVE
- BUTTERFLY VALVE
- PLUG VALVE
- NORMALLY CLOSED VALVE
- PUMP STATION
- HWL / BASE ELEV. STORAGE RESERVOIR
- PRIMARY SUPPLY
- EMERGENCY OR BACK-UP SUPPLY

PROPOSED FACILITIES:

- NEW OR UPGRADED PUMP STATION
- NEW OR UPGRADED PRV/PSV
- HWL / BASE ELEV. NEW STORAGE RESERVOIR

NOTE:

VALVE ID NUMBERS CORRESPOND TO ID NUMBERS IN THE CONTROL VALVE SUMMARY TABLES.

FIGURE 2-7

CARLSBAD MUNICIPAL WATER DISTRICT ULTIMATE SYSTEM HYDRAULIC PROFILE

DUDEK & ASSOCIATES, INC.

Model results from the maximum day demand simulation were reviewed to assess system operations and reservoir performance. The existing reservoirs in the ultimate system were able to supply operational storage and refill.

Emergency Supply Scenario - The ultimate system model was analyzed under an emergency supply scenario, with average day demands supplied from the Maerkle Dam. In this simulation, the bypass at the Maerkle Control Valve was opened to create an integrated 490-550 zone and the Calavera Hills Pump Station was operated to supply the 580 Zone. The capacity of the proposed 700 Zone emergency supply pump station was set equal to the average day demand of the 700, 680 580S and 510 Zones, which is approximately 3.6 MGD or 2,500 gpm.

A 24-hour simulation was run, and model results indicated that average day demands could be supplied to the entire distribution system from Maerkle Reservoir. However, the capacity of the Maerkle Reservoir Pump Station, which supplies Maerkle Reservoir from Maerkle Dam, will have to be increased to approximately 16,500 gpm (23.9 MGD). Although pressures in the 550 Zone dropped by approximately 25 psi, analysis results indicate that the required 40 psi minimum pressure could be maintained.

2.5.4 Storage Analysis

The required storage volume based on projected ultimate demands is calculated and compared to the capacity of the existing system reservoirs. Calculations to determine the required storage volume are shown in Table 2-8. Based on these calculations, there is projected to be a storage deficit of approximately 4.5 million gallons (MG) in the ultimate system. Additionally, the District is considering the removal of the 1.5 MG "E" Reservoir from the system, which does not operate together with the other two 255 Zone reservoirs due to its elevation.

The CMWD emergency storage policy is to provide 10 days of average water use. Based on the projected ultimate average annual demand of 23.9 MGD, the required storage volume is 239 MG. If demands identified as being supplied from the future Phase II Recycled Water System are not included, the projected ultimate demand is approximately 21.2 MGD, and 212 MG of emergency storage will be required. Maerkle Dam is reported to have a storage capacity of 195 MG. Therefore, additional storage will need to be constructed to comply with the CMWD emergency storage policy.

Table 2-8
ULTIMATE DAILY STORAGE REQUIREMENTS

RESERVOIR	Service Zones	Projected Demand		Storage Requirements				Reservoir Capacity	Available Emergency Capacity
		ADD (MGD)	MDD (MGD)	Operational (.15 x MDD)	Fire Flow (1)	Reserve (1 MDD)	Total		
Santa Fe II & La Costa High	700 680 580S 510 550 430	2.80 0.42 0.06 0.31 3.86 0.21	4.61 0.70 0.10 0.52 6.38 0.35	1.9 MG	2.88 MG	12.7 MG	17.4 MG	15.0 MG	-2.4 MG
Maerkle Res.	490 285 198	0.36 0.14 0.08	0.60 0.24 0.13	0.1 MG	0.96 MG	1.0 MG	2.1 MG	10.0 MG	7.9 MG
TAP	580 (2) 446 349	0.51 2.25 0.09	0.85 3.71 0.15	0.7 MG	0.96 MG	4.7 MG	6.4 MG	6.0 MG	-0.4 MG
D3	375	4.02	6.64	1.0 MG	1.92 MG	6.6 MG	9.6 MG	8.5 MG	-1.1 MG
La Costa Lo	318	3.60	5.94	0.9 MG	0.96 MG	5.9 MG	7.8 MG	1.5 MG	-6.3 MG
Ellery	330	1.10	1.82	0.3 MG	0.96 MG	1.8 MG	3.0 MG	5.0 MG	2.0 MG
Elm Skyline "E" Res.	255	4.07	6.72	1.0 MG	0.96 MG	6.7 MG	8.7 MG	4.5 MG	-4.2 MG
TOTALS		**23.9**	**39.4**	**5.9 MG**	**9.6 MG**	**39.4 MG**	**55.0 MG**	**50.5 MG**	**-4.5 MG**

(1) Equal to the volume of water based on the largest fire flow within the tank service area (flow rate times duration). For large service areas, the fire flow storage was increased based on the potential for multiple fires.
(2) The 580 Zone has no available storage but can be supplied from the TAP Res. through the Calavera Pump Station.

2.6 WATER QUALITY

Maerkle Dam provides storage capacity for daily operational needs and supplies the distribution system when imported water is not available from the SDCWA (due to aqueduct and treatment plant shutdowns). The dam is also used to maintain sufficient local storage to meet the City's "Growth Management Requirement", which states that the CMWD is to maintain 10 days of storage for the distribution system. These storage requirements, however, are affecting CMWD's ability to maintain water quality in Maerkle Dam.

The treated water purchased from the SDCWA uses chloramines as the secondary or residual disinfectant. The water therefore contains low concentrations of ammonia, which serves as a potential source of reduced nitrogen. Due to the presence of ammonia combined with the long residence time in Maerkle Dam, additional treatment of the water is required to avoid water quality complications due to nitrification. Nitrification is the result of biological conversion of ammonia to nitrite, which represents an oxidant demand. Historically, CMWD practiced breakpoint chlorination to remove the ammonia and produce a free chlorine residual in the reservoir influent water. However, this practice formed high concentrations of disinfection byproducts (DBPs) and may have adverse consequences for water system operation and compliance with the newly effective Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule and the soon to be proposed Stage 2 D/DBP Rule.

To address both the elevated DBP formation and the potential for nitrification, CMWD requested an amendment to its "Domestic Water Supply Permit" to test the use of chlorine dioxide for control of DBP formation and nitrification. An amendment was issued on June 5, 2002 by the California Department of Health Services (DOHS) under permit amendment 05-14-02PA-002. On June 19, 2002, CMWD discontinued its current practice of breakpoint chlorination and began testing the use of chlorine dioxide to reduce organohalide DBP formation and produce a new byproduct, chlorite, to control nitrification. Monitoring results for chlorine dioxide in the unblended Maerkle Dam effluent feed show very steady, predictable, and satisfactory results. The chlorite dioxide residual in the reservoir effluent is well below 0.64 mg/L (80% of Maximum Residual Disinfectant Level) and the daily chlorite level in the reservoir effluent was well below 0.80 mg/L (80% of the Maximum Contaminant Level). The weekly nitrite level in the reservoir effluent has stayed below 0.010 mg/L with a stable chloramine residual being observed (~1.0 mg/L), even after several months of detention in the reservoir.

With the cessation of breakpoint chlorination, the concentration of total trihalomethanes (TTHM) in the Maerkle Dam effluent is rapidly decreasing, and distribution system concentrations also appear to be decreasing. TTHM in the Maerkle Dam effluent have now approached the influent concentrations found in the treated water supply from the SDCWA. For these reasons, CMWD plans to continue the use of chlorine dioxide. This results in the need for a permanent installation of a chlorine dioxide generator and chemical storage facility. A decision on the permanent installation will be delayed until after the seawater desalination project has been decided upon, which calls for desalinated water to be stored at Maerkle Dam (discussed in the next section).

2.7 SEAWATER DESALINATION

A feasibility study has been prepared by a private company for a future 50 MG seawater desalination facility adjacent to the Encina Power Plant. The plant could eventually be expanded to a 100MG facility. The high quality drinking water would be sold based on long-term water sales agreements, and a draft water purchase agreement has been submitted to the SDCWA for their consideration. The proposed desalination plant would deliver desalinated water to CMWD, the City of Oceanside, VID, VWD, and the SDCWA. Desalinated water would be pumped from the desalination facility in a new 48-inch diameter pipeline to Maerkle Dam and Maerkle Reservoir prior to distribution to the various use areas. Maerkle Dam would therefore be converted to a desalinated water storage facility.

CMWD is currently conducting its own internal evaluation of the desalination study separate from the Water Master Plan Update. SDCWA staff is also reviewing the feasibility study and is in discussion with staff at Carlsbad and Oceanside over coordinating technical review of the proposal. CMWD has expressed concern over the mixing of desalinated water with imported water from the SDCWA, and the effect of changing supply sources on customers. Specifically, changes in taste, mineral content, and the overall water hardness may adversely affect customers who, under various seasonal supply scenarios, would be delivered either desalinated water, imported water, or a mixture of both supplies. The CMWD has therefore requested first rights to the desalinated water in order to supply all of its customers from a single source.

If the desalination plant is constructed there will be numerous impacts to the City of Carlsbad and the operation of the CMWD distribution system. In addition to new pipelines, a new pump station will be required at Maerkle Dam to pump desalinated water back into the SDCWA tri-agency pipeline and an additional CMWD pumping facility would be required to supply the upper zones with desalinated water from Maerkle Reservoir. Emergency storage rights for the water in Maerkle Dam will need to be negotiated. The potential impacts of changing the water supply to a desalinated source also need further investigation.

2.8 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Water distribution system improvements are recommended to supply future demands and improve system reliability. The recommended CIP includes the CMWD-funded projects proposed for build-out of the water distribution system, which is projected to occur by the year 2020. The proposed improvements are illustrated on Exhibit 3 in Appendix A and are summarized by phase with an opinion of probable construction cost in Table 2-9. The projects have been grouped into phases to address proposed improvements to the existing distribution system in Phase I, improvements to provide an emergency water supply to the entire distribution system from Maerkle Dam in Phase II, and improvements required for future development in Phase III. These phases should provide the CMWD with a long range planning tool to keep up with growth and provide for expansion of the water distribution system in an orderly manner. It is noted that phasing for recommended improvement projects may be accelerated or deterred to account for changes in development schedules, availability of land or rights-of-way for construction, funding limitations, and other considerations that cannot be predicted at this time.

Fourteen projects are recommended to increase the available fire flow capacity in the existing system. The majority of the recommended fire flow projects consists of replacing older 6-inch diameter pipelines with larger diameter pipelines. Four projects are recommend to increase the reliability of the existing system, based on the CMWD requirement that no more than 18 houses are to be served from a dead-end water line. Several water system improvements are required to supply the entire distribution system from storage in Maerkle Dam. These projects include increasing the capacity of the Maerkle Pump Station, constructing a second transmission main from Maerkle Reservoir to the 490 Zone distribution system to increase capacity, construction of additional delivery mains and reducing stations to supply the 446 and 375 Zones from the 490 Zone, replacement of the existing 20-inch diameter pipeline in El Camino Real upstream of the Maerkle Control Vault with a 30-inch diameter pipeline, and construction of an emergency pump station to supply the 700 Zone from the 490 Zone.

Several transmission main capacity improvements are recommended in the ultimate distribution system to supply future demands. Generally, distribution pipelines 12-inches in diameter and smaller required to serve future development projects are considered developer-funded projects. Larger pipelines are included in the CIP. In some cases, both the developer and the CMWD will share pipeline project costs. Transmission system capacity improvements are recommended for the 700 Zone to supply increased demands and also to integrate the existing 700N and 700S Zones into a single zone.

Based on projected ultimate demands and the planned removal of the "C" Reservoir form the potable water distribution system, there will be a daily storage deficit of approximately 4.5 MG within the distribution system. The storage deficit will increase by an additional 1.5 MG if the CMWD decides to remove the "E" Reservoir from service. It is recommended that the daily storage deficit be met by constructing an additional reservoir at the D3 Reservoir site, where there is already a reservoir pad in place on District-owned property. To operate efficiently in the distribution system, it is recommended that a "twin" reservoir be constructed with the same dimensions and capacity as the existing 8.5 MG D3 Reservoir.

During completion of this planning document, City Staff decided that the 10-day emergency storage requirement is to be calculated based on the projected ultimate ADD without Phase II recycled water demands. To meet the future emergency storage deficit, construction of an additional reservoir adjacent to Maerkle Dam was recommended in the last Master Plan. This previous storage solution has been carried forward at the request of District Staff, and a buried reservoir with a capacity of 15 MG is recommended to provide the required 10-days of emergency storage at build-out conditions (CIP No. 28).

Table 2-9
CMWD RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Label	Zone	Description/Location	Project Type	Existing Diam.	New Dam.	Pipeline Length	Unit Cost Estimate*	35% Contingency	Total Constr. Cost *	Benefit/Comments
				PHASE I - EXISTING SYSTEM IMPROVEMENTS						
F 1	330	Upsize 6" and 4" PL in Jeanne Place to end of cul-de-sac	Pipeline Replacement	6-in.	8-in.	600'	$95 /linear ft.	$33	$ 76,800	Upsize to provide Residential fire flow
F 2	446	Upsize 6" PL in Nob Hill Drive to end of cul-de-sac	Pipeline Replacement	6-in.	8-in.	650'	$95 /linear ft.	$33	$ 83,200	Upsize to provide Residential fire flow
F 3	446	Upsize 6" PL in Holly Brae Lane and Alder Ave east of Skyline Dr.	Pipeline Replacement	6-in.	8-in.	890'	$95 /linear ft.	$33	$ 114,000	Upsize to provide Residential fire flow
F 4	446	Upsize 6" PL in Falcon Dr. east of Donna Dr. to cul-de-sac	Pipeline Replacement	6-in.	8-in.	870'	$95 /linear ft.	$33	$ 111,400	Upsize to provide Residential fire flow
F 5	255	Upsize 6" PL in Cynthia Ln & Gregory Dr, from Knowles Av to cul-de-sac	Pipeline Replacement	6-in.	8-in.	710'	$95 /linear ft.	$33	$ 90,900	Upsize to provide Residential fire flow
F 6	330	Upsize 6" PL in Tamarack Av from Highland Drive west to Adair St., and in Adair St to cul-de-sac	Pipeline Replacement	6-in.	8-in.	1250'	$95 /linear ft.	$33	$ 160,100	Upsize to provide Residential and Multi-family fire flow
F 7	330	Upsize 6" PL in Highland Dr. from Yourell Ave to Ratcliff	Pipeline Replacement	6-in.	8-in.	700'	$95 /linear ft.	$33	$ 89,600	Upsize to provide Residential fire flow
F 8	580	Switch supply to hydrants at the Calavera Rec. center from the 580 Zone to the 446 Zone	New Connection to Fire Hydrants	NA	NA	NA	$25,000 L.S.	$8,750	$ 33,750	The 580 Zone has no storage. Modify system to provide Comm/Ind fire flow to recreation center from the 446 Zone and TAP Reservoir
F 9	330	Upsize 6" PL from Chestnut Ave at Woodland Way to the end of Woodland	Pipeline Replacement	6-in.	8-in.	560'	$95 /linear ft.	$33	$ 71,700	Upsize to provide Multi-Family fire flow
F 10	255	Upsize 6" PL in Garfield from Chinquapin Ave to end of cul-de-sac	Pipeline Replacement	6-in.	8-in.	846'	$95 /linear ft.	$33	$ 108,300	Upsize to provide Comm/Ind fire flow
F 11	255	Upsize 6" PL in Arland Road from Highland to Buena Vista Way	Pipeline Replacement	6-in.	12-in.	780'	$116 /linear ft.	$41	$ 121,900	Upsize to provide Comm/Ind fire flow
F 12	330	Install parallel pipeline in Highland Dr. from Hillside Dr. south to Adams St.	New Watermain	6-in.	8-in.	2400'	$95 /linear ft.	$33	$ 307,300	Upsize to provide Residential fire flow & provide redundant supply
F 13	255	Install parallel pipeline in Cove Drive from Park Drive to end.	New Watermain	6-in.	10-in.	1300'	$106 /linear ft.	$37	$ 185,700	Upsize to provide Multi-Family fire flow & provide redundant supply
F 14	680	High elevation areas in the vinicity of Obelisco Place/Circle	emergency pump	NA	NA	NA	$75,000 L.S.	$26,250	$ 101,250	Install emergency pump to boost pressures & provide the req'd fire flow @ 20psi
2	255	Parallel existing. 8" PL in Crestview Drive south of El Camino Real	New Watermain	8-in.	8-in.	600'	$95 /linear ft.	$33	$ 76,800	Provides redundant supply to existing residential area
3	255	El Camino Real south from Kelly Drive to Lisa Street	New Watermain	NA	10-in.	1500'	$106 /linear ft.	$37	$ 214,300	Provides looping to improve pressures and reliability
16	550	El Camino Real from Palomar Airport Road south to Cassia Road	Watermain Replacement	20-in.	24-in.	6100'	$240 /linear ft.	$84	$ 1,976,400	Replace existing pipeline and provide increased flow capacity
17	375	Poinsettia Lane west from Skimmer Ct. to Blackrail Rd.	New Watermain	NA	12-in.	4500'	$116 /linear ft.	$41	$ 703,000	Completes 375 Loop along Poinsettia Lane; Increase capacity to/from the D3 Reservoir
18	550	Poinsettia Road, 1100 feet east of Blackrail Rd.	Watermain Replacement	18-in.	30-in.	1100'	$250 /linear ft.	$88	$ 371,300	Increase supply to 550 Zone and D3 Reservoir
19	550	Aviara Pky at Plum Tree north to Mariposa St, then east to Sapphire Dr.	New Watermain	NA	8-in.	3100'	$95 /linear ft.	$33	$ 397,000	Provide redundant supply to residential development
21	680	Intersection of El Fuerte and Corintia St.	New 700 => 680 PRS	NA	NA	NA	$100,000 L.S.	$35,000	$ 135,000	Provide redundant supply to 680, 580S and 510 Zones
22	318	Carlsbad Boulevard from Avenida Encinas south to the District boundary	New Watermain	NA	12-in.	4900'	$116 /linear ft.	$41	$ 765,500	Provide 2-way emergency conn w/SDWD 240 Zone; can supply to 318 Zone west of I-5

Table 2-9 *(continued)*

Label	Zone	Description/Location	Project Type	Existing Diam.	New Dam.	Pipeline Length	Unit Cost Estimate*	35% Contingency	Total Constr. Cost *	Benefit/Comments
PHASE I - EXISTING SYSTEM IMPROVEMENTS *(continued)*										
24	550	Parallel existing PL in Poinsettia Road from Ambrosia Ln. to Blackrail Rd.	New Watermain	18-in & 30-in	12-in.	2000'	$116 /linear ft.	$41	$ 312,400	Provide redundant supply to residential developments
26	700	Palomar Airport Road west of SDCWA Connection #1	Watermain Replacement	20-in.	30-in.	1500'	$250 /linear ft.	$88	$ 506,300	Reduce velocity & provide increased capacity from SDCWA #1 Connection into 700 Zone.
31	490	El Camino crossing at Kelly Dr.	New watermain	NA	12-in.	300	$124 /linear ft.	$43	$ 50,200	Increase supply to the 255 Zone directly from the 490 Zone thru the Kelly PRS
32	NA	Abandonment of 9 wells at the Foussart well field	well abandonment	NA	NA	NA	$150,000 L.S.	$52,500	$ 202,500	Abandon wells per State standards; removal of pumps, structures & restoration of property
33	NA	Lake Calavera Reservoir Improvements	reservoir improvements	NA	NA	NA	$1,200,000 L.S.	$420,000	$ 1,620,000	Replacement of outlet tower valves and piping; Re-grade reservoir bottom
34	255	Oceanside Intertie Upgrade	intertie upgrade	NA	NA	NA	$75,000 L.S.	$26,250	$ 101,250	Valve, pipeline and meter replacements for the existing inter-tie
36	NA	Groundwater/seawater desalination study	report/study	NA	NA	NA	NA	NA	$ 649,860	Investigate treatment/delivery of City owned groundwater;seawater desalination feasibility
								Subtotal Phase I Improvements:	**$ 9,738,000**	
PHASE II - EMERGENCY SUPPLY										
4	375	Bryant Drive from Longfellow to El Camino Real, south on El Camino Real to College and northeast on College to Badger Lane	New Watermain	NA	12-in.	4000'	$116 /linear ft.	$41	$ 624,900	Connects isolated portions of 375 Zone & provides for supply from Maerkle Res. for ex. and future development.
5	490	Upsize existing 20" to 30" along El Camino Real from Cougar Dr. to Faraday Ave including Maerkle Control Valve	Watermain Replacement & valve	20-in.	30-in.	1500'	$250 /linear ft. $150,000 L.S.	$88 $52,500	$ 708,800	Larger diam. pipe reduces pressure loss during emergency supply to 550 Zone from Maerkle Dam
6	490/ 446	College Blvd from Carlsbad Village Drive south to Cannon Road, 490=>446 PRS	New Watermain & PRS	NA	16-in.	6330'	$133 /linear ft. $100,000 L.S.	$47 $35,000	$ 1,273,600	Increase supply capacity to 446 Zone from Maerkle Res.
7	490	College Blvd from future intersection with Cannon south to future Tee leading to Maerkle Reservoir	New Watermain	NA	16-in.	4000'	$133 /linear ft.	$47	$ 719,500	Primary feed for Robertson Ranch (490=>255 PRV); Increase supply capacity from Maerkle
10	490	In College Ave, from Badger Lane north aprrox. 1,200 ft, then east through future development	New Watermain	NA	36-in.	5200'	$220 /linear ft.	$77	$ 1,544,400	Increase supply capacity from Maerkle Res and provide a redundant supply pipeline
11	490	Connection from terminus of Project #10 to Maerkle Reservoir	New Watermain	NA	36-in.	4100'	$220 /linear ft.	$77	$ 1,217,700	Increase supply from Maerkle Res.; Supply to new 490 development east of El Camino and Rancho Carlsbad golf course.
15	700	El Fuerte Street from Palomar Airport Road south to Rancho Pancho	New Watermain	NA	24-in.	5200'	$163 /linear ft.	$57	$ 1,141,000	Connects 700N and 700S Zones; Supply for future development
20	700	Northeast corner of El Camino Real and Palomar Airport Road	Pump Station	NA	Capacity = 2,500 gpm		$900,000 L.S.	$315,000	$ 1,215,000	Provide emergency supply to 700, 680, 580S, and 510 Zones from Maerkle Res; Pump Station sized to supply the projected ult AAD of the zones supplied.
23	375	Cannon Road, 1,800 feet NE from Faraday Road	New Watermain	NA	16-in.	2760'	$133 /linear ft.	$47	$ 496,500	Provide for 375 supply from Maerkle Res; Increased capacity for future development
29 (a)	490	Maerkle Pump Station Capacity Improvements	Enlarge Pump Station	NA	Additional capacity = 5,000 gpm		$500,000 L.S.	$175,000	$ 675,000	Req'd for emergency supply from Maerkle Dam. Increase PS capacity to existing ADD
								Subtotal Phase II Improvements:	**$ 9,616,000**	

Table 2-9 *(continued)*

Label	Zone	Description/Location	Project Type	Existing Diam.	New Dam.	Pipeline Length	Const. Unit Cost	35% Contingency	Total Est. Cost *	Comment
PHASE III - FUTURE DEVELOPMENT										
1	255	From end of Marron Road east to Tamarack; 446=>255 PRV at Tamarack	New Watermain & PRS	NA	12-in.	6600'	$116 /linear ft. $100,000 L.S.	$41 $35,000	$ 1,168,600	Supply new developments in LFMZ 25 & provide additional supply to the 255 Zone
8	375	College Blvd from Cannon Road south to Badger Lane	New Watermain	NA	12-in.	4130'	$116 /linear ft.	$41	$ 645,200	Supply for new development and creates 375 Zone loop east of El Camino
9	375	In Cannon Rd., from Merwin Drive east to intersection with future College Blvd.	New Watermain	NA	12-in.	4400'	$116 /linear ft.	$41	$ 687,400	Supply for new development and creates 375 Zone loop east of El Camino
12	700	In future extension of Melrose Dr., from PAR north to future Faraday Rd.	New Watermain	NA	16-in.	4000'	$133 /linear ft.	$47	$ 719,500	Provides looped supply to new North 700 zone business park in LFMZ 16 (1 of 3)
13	700	In northern El Fuerte St. extension, to future Faraday Road	New Watermain	NA	16-in.	2200'	$133 /linear ft.	$47	$ 395,700	Provides looped supply to new North 700 zone business park in LFMZ 16 (2 of 3)
14	700	In future Faraday Rd. extension, between El Fuerte St. and Melrose Dr.	New Watermain	NA	16-in.	3600'	$133 /linear ft.	$47	$ 647,600	Provides looped supply to LFMZ 16 (3 of 3) and supply to 550 Zone from 700=>550 PRV
25	375	Poinsettia Road from El Camino Real west to Skimmer Court (Poinsettia Lane)	New Watermain	NA	12-in.	1300'	$116 /linear ft.	$41	$ 203,100	Parallel existing 8-inch to increase capacity in the 375 Zone and supply from the 550 Zone thru Villages of La Costa
27	375	Construct new 375 Zone water reservoir next to existing D-3 Reservoir	New Water Storage Reservoir	NA	Capacity = 8.5 MG		$0.60/ gal	$0.21/ gal	$ 6,885,000	Provides additional daily storage within the distribution system for ultimate demands
28	490	Construct buried storage reservoir next to existing Maerkle Reservoir	New Water Storage Reservoir	NA	Capacity = 15 MG		$1.00/ gal	$0.35/ gal	$ 11,475,000	Provides additional emergency storage to meet 10-day storage criteria based on ultimate demands
29(b)	490	Maerkle Pump Station Capacity Improvements	Enlarge Pump Station	NA	Additional capacity = 5,000 gpm		$500,000 L.S.	$175,000	$ 675,000	Req'd for emergency supply from Maerkle Dam. Increase PS capacity to projected ADD
30	375	Gross Pressure Reducing Station Improvements	490=>375 PRS Upgrade	NA	NA	NA	$75,000 L.S.	$26,250	$ 101,250	Increase capacity of existing Gross PRS to supply new development from 490 Zone
35	392	Install 490=>392 PRS at Cannon Road and College Blvd.	490=>392 PRS	NA	NA	NA	$100,000 L.S.	$35,000	$ 135,000	Project will take place when existing "C" Reservoir is taken out of service
37	580	Calavera Pump Station Improvements, College Blvd at Carlsbad Village Dr.	PS upgrades	NA	NA	NA	$300,000 L.S.	$105,000	$ 405,000	Install standby generator & building, hydropneumatic tank & add'l pump
								Subtotal Phase III Improvements:	**$24,143,000**	
			CIP TOTAL PHASES I - III						**$43,497,000**	

* Opinion of probable construction cost is based on a Construction Cost Index (CCI) of 6578 for November 2002.

CHAPTER 3
EXISTING SYSTEM DESCRIPTION

This chapter summarizes the existing CMWD distribution system as of December 2001. The facilities comprising the water distribution system include San Diego County Water Authority (SDCWA) turnouts, transmission mains, distribution pipelines, pressure reducing stations, storage reservoirs and pump stations. Information regarding the existing water distribution system facilities was derived from the District's water atlas books, as-built construction drawings, previous reports and studies, and input from City of Carlsbad Engineering and Public Works staff. The existing water distribution system is illustrated on the color wall map provided as Exhibit 1 in Appendix A.

3.1 GENERAL

The CMWD service area includes the majority of the City boundary, with the exception of the southeast corner of the City. Water distribution in the southeastern area is provided by the Olivenhain Municipal Water District (OMWD). Carlsbad's water service area extends from the Buena Vista Lagoon and Creek south to the Batiquitos Lagoon, and from the Pacific Coast to approximately 5 miles inland. The approximately 32 square mile service area is characterized by gently rolling to highly dissected mesa-like hills, commonly topped by remnants of marine terraces. Elevations range from sea level along the coast to just under 600 feet along the eastern boundary. The mean temperature range for the District's service area is typically between 55°F in January to approximately 70°F in August. The average annual precipitation within the service area ranges from 11 to 15 inches. Precipitation generally occurs between the months of November and March.

3.2 WATER SUPPLY

The CMWD imports water through the SDCWA for their potable water needs. Water is supplied to the CMWD through four separate SDCWA treated water turnouts. Two of the turnouts, CWA No. 1 and CWA No. 2, are direct connections to the SDCWA Second Aqueduct. CWA No. 1 supplies only the CMWD, and CWA No. 2 supplies the Vallecitos Water District (VWD) and the Olivenhain Municipal Water District (OMWD) in addition to the CMWD. Water supply to the CMWD from CWA No. 2 is delivered through a VWD transmission main. Connections No. 3 and No. 4 to the aqueduct system are on the SDCWA owned and operated Tri-Agency Pipeline (TAP), which is also supplied from the SDCWA Second Aqueduct. The TAP also serves the City of Oceanside and the Vista Irrigation District (VID). The SDCWA aqueduct connections are summarized in Table 3-1. Emergency sources of water are discussed later in this chapter (Section 3.4).

Table 3-1
SDCWA AQUEDUCT CONNECTIONS

San Diego County Water Authority Connection	Supply Source	Rated Capacity*		Normal Delivery Rate Range				Supply Zone/ Reservoir
				Summer		Winter		
		(cfs)	(MGD)	(cfs)	(MGD)	(cfs)	(MGD)	
CWA No. 1 (Palomar Airport Road Connection)	Second SDCWA Aqueduct	36	23	11 - 22	7 - 14	6 - 15	4 - 10	700N/ Sante Fe II Reservoir
CWA No. 2	Second SDCWA Aqueduct	13.3	9	3 - 10	2 - 6	2 - 4	1 - 3	700S/ La Costa Hi Reservoir
TAP No. 3 (Maerkle Connection)	Tri-Agency Pipeline (TAP)	18	12	7 - 10	5 - 6	3 - 8	2 - 5	490/ Maerkle Reservoir
TAP No. 4 (TAP Connection)	Tri-Agency Pipeline (TAP)	13.5	9	4 - 10	3 - 6	2 - 5	1 - 3	580/ TAP Reservoir (446 Zone)
	TOTALS	**81**	**52**	**25 - 52**	**16 - 34**	**13 - 32**	**8 - 21**	

* Rated capacity for Conn. No. 1, 3 and 4 is the capacity of the SDCWA meter at the turnout, minus 10%. Rated capacity for Conn. No. 2 is based on a contractual agreement with VWD, OMWD, and Carlsbad. The maximum flow that can be delivered may be less due to downstream pipeline capacity limitations.

CMWD operations staff remotely set daily water delivery rates for the SDCWA turnouts. Water order requests are made to the SDCWA 24-hours prior to delivery. Presently the CMWD has an option to adjust flow through any of the four connections twice a day. With the exception of the TAP No. 4 connection, water is supplied directly to zones with a reservoir to ensure that a constant flow rate can be provided regardless of demands in the system. Flow from the TAP No. 4 connection is supplied to the 580 Zone, which has no storage reservoir. However, a sustaining valve from the 580 Zone to the 490 Zone allows the 490 Zone TAP Reservoir to provide buffering capabilities for this connection.

3.3 WATER DISTRIBUTION SYSTEM

The existing distribution system consists of 17 major pressure zones. Four of the zones are supplied directly from the SDCWA aqueduct connections (700N, 700S, 490, 580). The remaining zones are supplied through pressure reducing stations. The CMWD hydraulic profile schematic showing aqueduct connections, pressures zones, storage facilities, pump stations and primary pressure reducing stations is provided on Figure 3-1.

3.3.1 Pressure Zones

The CMWD distribution system consists of 17 major pressure zones and several smaller reduced zones with private distribution systems. Of the 17 major zones, nine are open zones with reservoirs. The remainder are closed zones with pressure regulating valves. Pressure zones within the CMWD are identified by a number that typically corresponds to the bottom elevation of the reservoir or, for zones without storage, the hydraulic grade set by the primary pressure reducing station.

The pressure zone service areas are illustrated on Figure 3-2, along with the existing distribution system pipelines. The service area boundaries have been updated from the previous Master Plan based on input from City operations staff. The zone boundaries were further modified based on existing elevations and planned development for ultimate conditions. Therefore, some of the service areas identified on Figure 3-2 do not have any existing distribution pipelines. It is noted that the existing 700N and 700S Zones are planned to be combined and operated as a single zone in the near future.

3.3.2 Distribution Pipelines

The existing distribution system has over 300 miles of pipelines 6-inches in diameter and larger. Most of the pipelines are constructed of asbestos cement pipe (ACP). Larger transmission mains are constructed of CMLC steel and newer pipelines are primarily polyvinyl chloride (PVC). For this Master Plan Update, the existing system computer model developed as part of the previous Master Plan was reviewed and updated to reflect current conditions. The 2001 model includes major delivery mains and looped distribution pipelines. Onsite distribution pipelines through commercial properties and smaller dead-end pipelines are typically not included in the model. The pipelines color-coded by pressure zone in the updated existing system model are shown on Exhibit 1 in Appendix A. Table 3-2 summarizes pipeline lengths by diameter included in the hydraulic model.

Table 3-2
HYDRAULIC MODEL PIPELINE SUMMARY

Pipeline Diameter (inches)	Total Pipeline Length (miles)	Pipeline Diameter (inches)	Total Pipeline Length (miles)
6	24.8	24	2.7
8	105.9	27	1.8
10	45.1	30	3.3
12	51.8	33	0.6
14	11.8	36	3.2
16	23.8	37	1.3
18	3.6	42	0.4
20	2.3	48	0.4
21	3.0		

3.3.3 Water Storage Facilities

Maerkle Dam is the major treated water storage facility for the CMWD, with a capacity of approximately 600 acre-feet (195.5 MG). This reservoir serves as an operational water supply and is also used in meeting the City's requirement to provide a minimum of ten days of emergency drinking water storage. Currently the high pressure zones in the southeast portion of the service area (700, 680, 580S and 510) cannot be supplied with emergency water from the dam. In 1998, CMWD installed a floating cover and an asphalt liner to Maerkle Dam to meet the State Department of Health Services standard requiring that reservoirs be lined and covered to prevent possible contamination. This standard complies with the Environmental Protection Agency's Surface Water Treatment Rule. Under normal operations, water is supplied to Maerkle Dam from the SDCWA TAP No. 3 connection and then pumped into the adjacent Maerkle Reservoir. From Maerkle Reservoir water is supplied by gravity to the distribution system.

Water storage for fire flow and daily water operations is provided by eleven reservoirs (enclosed storage tanks) within the distribution system. Additionally, there is one reservoir that is currently not in use (2.5 MG Santa Fe I). The existing operational storage capacity is 51.5 MG, excluding Maerkle Dam. Table 3-3 provides a summary of the storage facilities, including a small reservoir used as a forebay for the Buena Vista Pump Station. All water storage is above ground except for the Maerkle Dam and Maerkle Reservoir. The distribution system reservoirs have been designed to be extremely flexible in their ability to transfer water throughout the District. All reservoirs are constructed of steel except for the Santa Fe I, Santa Fe II, La Costa Hi and TAP reservoirs, all of which are circular pre-stressed concrete, and the buried 10 MG Maerkle reservoir, which is rectangular and constructed of reinforced concrete. Reservoir water levels are recorded by the CMWD SCADA (supervisory control and data acquisition) system.

The major pressure zones have at least one reservoir to regulate pressures and provide operational and fire flow storage, with the exception of the 580 Zone. The 580 Zone is supplied directly from the TAP No. 4 aqueduct connection. To regulate pressures in the 580 Zone, a pressure sustaining valve assembly is utilized which passes flow to the 446 Zone TAP Reservoir. In the event of a loss of water supply, a booster pump station can deliver 1,500 gallons per minute (the required residential fire flow) from the 446 Zone back to the 580 Zone.

Table 3-3
EXISTING RESERVOIR SUMMARY

Reservoir Name	Supply Zone	Tank Type	Bottom Elev. (ft)	Hi-water Level (ft)	Tank Height (ft)	Tank Dia. (ft.)	Storage Capacity (MG)	Reservoir Supply	
								Supply Source	Normal Fill Operation
Santa Fe II	700	Circular pre-stressed concrete	700.0	732.0	32.0	219	9.0	SDCWA Conn. #1	Direct from SDCWA #1
La Costa Hi	700	Circular pre-stressed concrete	700.0	727.0	27.0	194	6.0	SDCWA Conn. #2	Direct from SDCWA #2
Santa Fe I (1)	700	Circular	660.0	685.5	27.5	125	2.5	SDCWA Conn. #1	Disconnected from system in 1987
Maerkle Reservoir	490	reinforced concrete; baffled reservoir w/chloramination	491.3	514.0	22.8	267x 215 (rect.)	10.0	Maerkle Dam or TAP #3	Pumped from Maerkle Dam and/or direct from TAP #3
Maerkle Dam	490 (pumped)	lined dam with floating cover	442.5	500.0	61.0	--	195.0	TAP # 3	Direct from TAP #3
TAP	446	Circular pre-stressed concrete	446.0	473.0	27.0	194	6.0	TAP #4	Through 580 Zone from 580=>446 TAP #4 PSV
Cannon "C" (2)	392	circular steel	392.0	423.0	31.0	75	1.0	Maerkle Reservoir	periodic fill with manual valve (2)
D-3	375	circular steel	375.0	430.0	55.0	175	8.5	Santa Fe II Res. via 550 Zone	550=>375 PRV & throttled 12" plug valve
Ellery	330	circular steel	330.0	352.5	22.5	194	5.0	Maerkle Reservoir	Ellery Reservoir PSV 490=>330
La Costa Lo	318	circular steel	318.0	356.5	38.5	81	1.5	La Costa Hi/ D3 / Santa Fe II Res.	remote PRVs in 318 Zone
Buena Vista Forebay	330 (pumped)	circular steel	223	243	20.0	9	0.01	Skyline Reservoir	Used in emergency only
Skyline	255	circular steel	241.0	263.5	22.5	106	1.5	Maerkle/TAP Reservoirs	remote PRVs; tank has 12" altitude valve
"E"	255	circular steel	264.0	302.5	38.5	81	1.5	D3 Reservoir	throttled 8" plug valve; B'Fly valve downstream controls tank level.
Elm	255	circular steel	255.0	277.5	22.5	106	1.5	Maerkle/Ellery Reservoirs	remote PRVs; tank has 12" altitude valve
RESERVOIR CAPACITY TOTAL:							**249.0 MG**		

(1) Santa Fe I Reservoir is proposed to be used in the recycled water system in the future.
(2) Cannon "C" tank is being eliminated from the potable water system, and will be used in the Phase II Recycled Water System beginning 2004.

3.3.4 Pump Stations

There are four booster pump stations in the CMWD distribution system. Three are used for emergency purposes and the fourth, the Maerkle Reservoir Pump Station, supplies water from Maerkle Dam into Maerkle Reservoir. Under normal operations, this pump station is operated to circulate water in Maerkle Dam. In addition, the CMWD owns a trailer-mounted pump that can be used in emergency conditions. The location of each pump station is shown on Exhibit 1 in Appendix A and a summary of each permanent pump station is provided in Table 3-4.

Table 3-4
PUMP STATION SUMMARY

Pump Station	Suction Zone => Discharge Zone	Station Capacity (gpm)	Motor Size/Type	Back-Up Power	Comment
Maerkle Reservoir	Maerkle Dam => Maerkle Reservoir	7000	3-150 Hp/VFD	450 KW Generator	2 - 7.5 Hp solution pumps & 1-1¼ Hp mixing pump are in building
Ellery	330 => 446	1200 1000	1- 50 Hp 1- 40 Hp/VFD	None	Pump may operate during peak demand periods in response to a pressure drop.
Calavera Hills	446 => 580	1500	2 - 75 Hp	None	Emergency use only (580 Zone has no storage)
Buena Vista	255 => 330	1700	2 - 150 Hp	None	Emergency use only. 10,000 gal forebay

The 580 Pressure Zone is provided with emergency booster pumping from the Calavera Hills Pump Station located near the TAP Reservoir. The station has a capacity of 1,500 gpm to provide the required fire flow for the residential area. The electrical controls at the Ellery Pump Station are in need of replacement, which is scheduled to occur within the next year.

3.3.5 Pressure Regulating Stations

The CMWD utilizes pressure regulating stations to supply water to lower pressure zones from higher zones. The pressure regulating stations typically include combination pressure reducing and pressure sustaining valves (PRV/PSV). A combination PRV/PSV operates by reducing the downstream pressure for as long as the upstream pressure does not drop below a set point. In the event that the upstream pressure drops to the set point, the combination valve will switch to a pressure sustaining mode, effectively sacrificing the lower pressure zone setting to maintain the minimum upstream pressure. Under normal operations, a combination PRV/PSV operates in a pressure reducing mode.

The water distribution system operates with over 50 pressure regulating stations, and each station has one or more valves. Several stations operate in pure sustaining mode and several in pure reducing mode, but the majority of the stations have at least one combination PRV/PSV. There are also a few stations with plug valves. A summary of the main stations is provided in Table 3-5. Included in the table are the number, type and size of the valves and the current valve settings, as provided by CMWD operation staff.

Table 3-5
CONTROL VALVE SUMMARY

Supply Zone	Station Name	Station No.	Pressure Zone Up stream	Pressure Zone Down stream	Elev (feet)	Valve Type	Valve Size (in.)	Valve setting* (psi)	Valve setting* downstream grade	Valve setting* upstream grade	Comments
680											
	Alga Road PRV #1	1	700S => 680		438	PRV	8	95	657	---	Only supply to zone
						PRV	12	90	646	---	
580											
	TAP #4 Cannon	124	CWA => 580		403	PSV	12	230	---	934	Note: Hydraulic grade in 580 Zone is set by the Elm TAP PSV (580=>490)
580S											
	La Golondria	55	680 => 580S		356	PRV	2/6	90	564	---	Primary; 6" PRV set at 72psi
						PSV	6	100	---	587	
	Colibri PRV	20	680 => 580S		397	PRV	6	62	540	---	Secondary
550											
	North Point D	88	700N => 550		283	PRV	6/8	105	525	---	Backup
						PSV	6/8	165	---	664	
	South Point D	87	700N => 550		283	PRV	12/16	115	548	---	Main station
						PSV	12/16	165	---	664	
550E											
	Rancho Poncho	156	700S => 550E		192	PRV	6/8	130	492	---	
						PSV	6/8	200	---	653	
	Melrose	143	700N => 550E		322	PRV	6/10	80	507	---	
510											
	Unicornio	125	680 => 510		346	PRV	6	40	438	---	Backup
	El Fuerte and Bolero	34	680 => 510		400	PRV	6/10	45	504	---	Primary Feed
						PSV	10	100	---	631	
	Alga Road Station #2	2	680 => 510		383	PRV	8/10	50	498	---	Backup
						PSV	8/10	105	---	625	
490											
	Maerkle Control Vault	65	550 => 490		305	PLUG	20				Throttled to ~0-5 cfs; adjusted priodically
	Elm TAP	41	580 => 490			PSV	8		---	0	normally closed (manual operation)
446											
	TAP #4/Hi-Low Vault	122	580 => 446		440	PSV	10/10	50	---	556	Supply to TAP Res.; Sets 580 Zone grade
	Olympia	77	580 => 446		285	PRV	6/12	64	433	---	Backup
						PSV	6/12	84	---	479	
	Rising Glen	91	490 => 446		127	PRV	2/8	140	450	---	Usually closed; 2 & 8" PRV have the same setting
						PSV	2/8	150	---	474	
	Laguna Riviera	56	490 => 446		46	PRV	6	165	427	---	
	Chestnut	17	490 => 446		270	PRV	4/8	85	466	---	May run
						PSV	8	95	---	489	
	B-line valve vault	4	490 => 446			PLUG	14				normally not active
430											
	College East	21	550 => 430		206	PRV	6/8	98	432	---	Always runs
						PSV	6/8	120	---	483	
	Hailey	46	550 => 430		205	PRV	6/8	98	431	---	Always runs
						PSV	6/8	100	---	436	
375											
	D Reservoir	28	550 => 375		370	PRV	8/12	24	425	---	Fills Reservoir; Downstream 12" plug valve limits flow rate (28-32% open)
						PSV	8/12	45	---	474	
	College West	22	550 => 375		234	PRV	6/12	65	384	---	Primary
						PSV	6/12	100	---	465	
	Palomar Oaks	82	550 => 375		194	PRV	6/10	80	379	---	Always runs; 10" PRV set at 65 psi
						PSV	6/10	115	---	460	
	Grosse	43	490 => 375		95	PRV	6	130	395	---	Supplies isolated portion of zone
	Lower Faraday	170	430 => 375		120	PRV	4/6	105	363	---	
	Jackspar	48	430 => 375		105	PRV	4/6	100	336	---	Supplies isolated portion of zone
						PSV	4/6	120	---	382	

Table 3-5 *(Continued)*
CONTROL VALVE SUMMARY

Supply Zone	Station Name	Station No.	Pressure Zone: Up stream	Pressure Zone: Down stream	Elev (feet)	Valve Type	Valve Size (in.)	Valve setting*: (psi)	Valve setting*: downstream grade	Valve setting*: upstream grade	Comments
349											
	Tamarack Point	105	446 =>	349	170	PRV	2/8	60	308	---	
						PSV	8	85	---	366	
330											
	Ellery Reservoir	37	490 =>	330	326	PSV	14	72-80	---	492-511	Supply to reservoir; adjusted periodically
	Donna and Basswood	25	446 =>	330	245	PRV	8	35	326	---	Fire Flow only
	Clearview	19	446 =>	330	248	PRV	6	35	329	---	Fire Flow only
						PSV	6	50	---	364	
318											
	Ayres PRV	3	550 =>	318	196	PRV	6/12	60	334	---	Control by Telemetry; Big AM feed
						PSV	12	120	---	473	
	La Costa Low	52	510 =>	318	310	PSV	12	100	---	541	Supply to La Costa Lo Res.; Norm closed
	Lower El Fuerte	33	510 =>	318	210	PRV	8	62	353	---	Primary Feed for 318 Zone
	Bolero	6	510 =>	318	193	PRV	8	68	350	---	Backup to No. 33
						PSV	8	120	---	470	
	Poinsettia	85	375 =>	318	124	PRV	4/8	80	309	---	8" PRV set at 65 psi
						PSV	8	94		341	
	Las Ondas	59	375 =>	318	142	PRV	4	78	322	---	Small valve usually runs
						PRV	8	50	257	---	
	Blackrail	5	375 =>	318	50	PRV	6/12	116	318	---	Backup; can be major feed
						PSV	6/12	138	---	369	
285											
	Tanglewood	106	490 =>	285	126	PRV	4/10	80	311	---	
						PSV	10	170	---	519	
	Marron /Avenida de Anita	72	255 =>	285		check	10				Emergency/ Back-up only
255											
	May Co. PRV	73	490 =>	255	79	PRV	6/8	81	266	---	Primary feed
						PSV	6/8	135	---	391	
	Kelly PRV	49	446 =>	255	46	PRV	4/6	90	254	---	4" runs during high demands
						PSV	4/6	150	---	393	
	Sierra Morena	95	446 =>	255	105	PRV	8	56	234	---	Fire flow only; assumed elevation
						PSV	8	135	---	417	
	Skyline East	96	446 =>	255	105	PRV	2	60	243	---	Supply to Skyline Res.; Normally closed
						PSV	8	90	---	313	
	"E" Vault	32	375 =>	255	251	PLUG	8	adjusted to < 1/4 open			Supply to "E" Res.; B'fly valve on res. outlet limits flow from tank
	Palomar West	83	375 =>	255	78	PRV	6/8	73	246	---	Secondary feed; Usually runs
						PSV	6/8	115	---	344	
	Cannon	15	375 =>	255	125	PRV	4/8	45	229	---	Backup
	Pine	84	330 =>	255	138	PRV	3/8	45	242	---	Larger valve fire flow only
						PSV	3/8	75	---	311	
	Elm Res PSV	40	330 =>	255	240	PSV	10	45	---	344	Supply to Elm Res; Normally closed
	Buena Vista	7	330 =>	255	178	PRV	6/12	30	247	---	adjusted periiodically to run water thru 6"
	Encinas	42	318 =>	255	42	PRV	8	85	238	---	Back-up/fire flow
						PSV	8	100	---	273	
	Hilton	111	318 =>	255	46.5	PRV	4	85	243	---	
198 (private system)											
	Terramar #1	107	490 =>	374	50	PRV	8	90	258	---	Supplies mobile homes; There are 2 PRVs inseries
	Rancho Carlsbad	89	374 =>	198	50	PRV	6	60	188	---	

* For stations with muliple reducing valves, setting proivded is based on the smaller valve. The setting for the larger valve is typically 5 to 10 psi lower, unless noted otherwise. For PRV/PSV combination valves, sustaining setting is typcially 18-20 pounds lower than the normal upstream operating pressure.

3.4 INTER-TIE CONNECTIONS WITH OTHER AGENCIES

The CMWD has several inter-tie connections with the Oceanside Water District (OWD), Olivenhain Municipal Water District (OMWD), the Vista Irrigation District (VID), and the Vallecitos Water District (VWD), as summarized in Table 3-6. All but one of these inter-ties, the connection with the VWD that supplies water from the SDCWA No. 2 connection, are for use in the event of a planned aqueduct shut down or in the event of an emergency. There are a wide variety of physical inter-tie configurations, ranging from pressure control facilities with flow meters to a simple isolation valve, which could be opened manually to supply an isolated area of the distribution system. It is noted that many of the inter-tie connections with only closed valves are potential two-way connections that have never been used.

Table 3-6
OTHER AGENCY INTER-TIES

Agency	Location	Capacity	Purpose	Other Agency Zone	Carlsbad Zone	Flow Control
Oceanside	El Camino Real / Hwy 78	5 cfs	Supply during aqueduct shut down / Emergency	Henie Hills HWL = 409'	255	12" pipeline with plug valve and meter
Oceanside	College Blvd / City limits	--	Supply during aqueduct shut down / Emergency	San Francisco Peak - 481'	446	PRV for flow to Carlsbad & meter
OMWD	La Costa Ave / El Camino Real	5 cfs	Fire flow conn. to OMWD / Emergency	437	318	12" pipeline with 10" PRV set to 40 psi
OMWD	Calle Madero	--	Emergency Connection	437	318	Closed valve on 8" pipeline
OMWD	Nueva Castilla	--	Emergency Connection	437	318	Closed valve on 12" pipeline
OMWD	La Costa Ave / Romeria	--	Emergency Connection	437	318	Closed valve on 8" pipeline
VID	Palomar Airport Rd / Business Park Dr	3.3 cfs	Supply to CMWD during aqueduct shut down	690	700	Temp. pump installed with meter
VWD	El Fuerte / Corintia	--	Emergency Connection	686	700	Closed valve on 12" pipeline
VWD	Melrose / Alga	--	Emergency Connection	815	700	Closed valve on 12" pipeline
VWD	San Marcos Blvd / RSF Road	--	Emergency Connection	855	700	Closed valve
VWD	East of El Fuerte / Alga Rd.	13.3 cfs	Supply to CMWD from SDCWA Conn. No. 2	815	700	27" pipeline with flow control valve & meter

3.5 DAILY OPERATIONS

The CMWD water distribution system is flexible in that supply from the four aqueduct connections can be routed to different parts of the distribution system by making changes to several key valve settings. This allows system operators to balance reservoir levels and correct for discrepancies in the amount of water ordered versus the amount that is delivered through service connections. Reservoir water levels and several control valves are connected to the CMWD SCADA system so that some operational changes can be made remotely from the water operations center. Water Operations staff has stated that several operational changes and adjustments are typically made each day during peak demand periods. Changes that may be made under normal supply operations include:

- The Maerkle control valve structure consists of a 20-inch plug valve that separates the 490 Zone from the 550 Zone. Flow through this valve is metered and the valve may be closed or throttled to allow excess supply from the 700 Zones via the 550 Zone into the 490 Zone. Under emergency supply scenarios the valve can be opened to supply the 550 Zone from Maerkle Dam.

- The 375 Zone D3 Reservoir can be supplied from the 550 Zone via a pressure reducing station located adjacent to the reservoir. Downstream of this station is a 12-inch plug valve, which is typically throttled from 28 to 32 percent open to regulate reservoir water levels. Water supply to the D3 Reservoir can decrease significantly when supplemental potable water is supplied from the 550 Zone to the adjacent recycled water tanks.

- Supply to the 330 Zone Ellery Reservoir from the 490 Zone is controlled by a pressure sustaining valve. The setting of this valve is adjusted periodically, and typically ranges between 72 and 80 pounds per square inch (psi).

- The Aryes PRV supplies the 318 Zone from the 550 Zone. The valve setting can be changed by telemetry and is adjusted to regulate water levels in the 318 Zone La Costa Lo Reservoir.

- The Cannon C Reservoir establishes a 392 Zone that currently serves several agricultural customers. Supply to this reservoir is from the 490 Zone from a manual valve that is periodically opened to fill the reservoir. It is noted that the C Reservoir is planned to be removed from the potable water system in 2004 and will be used in the recycled water system.

- The 255 Zone E Reservoir is at a significantly higher elevation than the other two reservoirs in the 255 Zone. Because of this, the E Reservoir cannot “float” on the system and is considered an emergency storage reservoir only. Supply to the E Reservoir from the 375 Zone is controlled by a plug valve, which is typically set at less than 25 percent open. A butterfly valve on the outlet piping is throttled to control the reservoir supply rate.

With the exception of the controls described above, supply to most storage reservoirs in the distribution system is from pressure reducing stations remotely located from the tank at the edges of the service zone. Most reservoirs also have a direct supply to the tank, which is typically controlled by a valve setting to operate closed. These valve settings can be opened manually as needed to provide additional supply to the reservoirs. It is also noted that most reservoirs in the system do not have altitude valves.

3.6 EMERGENCY SUPPLY OPERATIONS

During planned shutdowns of the SDCWA aqueduct, which are normally scheduled for up to 10 days during the winter, most of the CMWD is supplied from Maerkle Dam through the 490 Zone Maerkle Reservoir. Supply to the 550 Zone is accomplished by closing off the normal supply from the 700 Zone (closing valves at pressure reducing stations) and opening the by-pass valve in the "Maerkle Control" vault. This allows the 490 Zone to supply the 550 Zone and effectively operate as a single pressure zone. Under normal operations existing pressures in the 550 service area are generally over 90 psi. Under emergency supply conditions pressures drop by approximately 25 to 35 psi, but are still high enough to meet minimum pressure criteria.

During an aqueduct shutdown the 700, 680, 580N and 510 Zones are currently supplied from the 700 Zone reservoirs (Santa Fe II and La Costa Hi) and an inter-tie with the VID. The VID shares ownership of a water treatment plant with the City of Escondido, and is therefore not completely dependent on supply from the treated water aqueduct. To boost VID system pressures and supply the 700 Zone, a rented water pump is installed at the inter-tie and operated at a capacity of approximately 1,500 gpm. To minimize the impact on the VID distribution system, the pump is not operated during the morning peak demand period. Supply to Carlsbad from the VID inter-tie is metered.

3.7 WELL WATER AND SURFACE WATER SUPPLIES

The CMWD has groundwater rights in the San Luis Rey Basin of 750 acre-feet per year, which is listed in State Water Resources Account No. 37-004C. CMWD owns nine groundwater wells located in Oceanside that have not been used for over thirty years. The location of the wells are shown in Figure 3-3. These wells do not currently contribute to the potable water distribution system. In 2003, CMWD will be removing all nine wells in accordance with California State Health Department requirements. Groundwater wells were also constructed in the vicinity of Carlsbad Ranch Mobile Home Park. Some of these wells are still used to supply water to the private golf course in the area. Additional Information on the groundwater wells is provided in the Water Resource Master Plan, Volume II of the 1997 Master Plan Update.

CMWD also has capacity rights to surface water in two locations. The first includes 750 acre-feet per year tributary to Lake Calavera. In the 1950's there was a water treatment plant downstream of the Dam for Lake Calavera. Surface water collected in the reservoir was treated and then supplied in a transmission main to the Terramar Area of Carlsbad. The second area of surface water includes capacity rights to 500 acre-feet per year tributary to Maerkle Dam.

3.8 Water Quality

Maerkle Dam provides storage capacity for daily operational needs and supplies the distribution system when imported water is not available from the SDCWA (due to aqueduct and treatment plant shutdowns). The dam is also used to maintain sufficient local storage to meet the City's "Growth Management Requirement", which states that the CMWD is to maintain 10 days of storage for the distribution system. These storage requirements, however, are affecting CMWD's ability to maintain water quality in Maerkle Dam.

The treated water purchased from the SDCWA uses chloramines as the secondary or residual disinfectant. The water therefore contains low concentrations of ammonia, which serves as a potential source of reduced nitrogen. Due to the presence of ammonia combined with the long residence time in Maerkle Dam, additional treatment of the water is required to avoid water quality complications due to nitrification. Nitrification is the result of biological conversion of ammonia to nitrite, which represents an oxidant demand. Historically, CMWD practiced breakpoint chlorination to remove the ammonia and produce a free chlorine residual in the reservoir influent water. However, this practice formed high concentrations of disinfection byproducts (DBPs) and may have adverse consequences for water system operation and compliance with the newly effective Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule and the soon to be proposed Stage 2 D/DBP Rule.

To address both the elevated DBP formation and the potential for nitrification, CMWD requested an amendment to its "Domestic Water Supply Permit" to test the use of chlorine dioxide for control of DBP formation and nitrification. An amendment was issued on June 5, 2002 by the California Department of Health Services (DOHS) under permit amendment 05-14-02PA-002. On June 19, 2002, CMWD discontinued its current practice of breakpoint chlorination and began testing the use of chlorine dioxide to reduce organohalide DBP formation and produce a new byproduct, chlorite, to control nitrification.

Monitoring results for chlorine dioxide in the unblended Maerkle Dam effluent feed show very steady, predictable, and satisfactory results. The chlorite dioxide residual in the reservoir effluent is well below 0.64 mg/L (80 % of Maximum Residual Disinfectant Level) and the daily chlorite level in the reservoir effluent was well below 0.80 mg/L (80% of the Maximum Contaminant Level). The weekly nitrite level in the reservoir effluent has stayed below 0.010 mg/L with a stable chloramine residual being observed (~1.0 mg/L), even after several months of detention in the reservoir.

With the cessation of breakpoint chlorination, TTHM concentrations in the Maerkle Dam effluent are rapidly decreasing, and distribution system concentrations also appear to be decreasing. TTHM in the Maerkle Dam effluent have now approached the influent concentrations found in the treated water supply from the SDCWA. For these reasons, CMWD plans to continue the use of chlorine dioxide.

CHAPTER 4
EXISTING WATER DEMANDS

As population expands and the northern coastal areas of San Diego County continue to develop, the City of Carlsbad has experienced gradually increasing water demands. This chapter documents existing potable water demands within the water service area. Historical water demands are summarized and water system peaking is analyzed and described. Peaking curves for two high demand days are developed based on recent flow data. Finally, unit demands are developed for residential and commercial/industrial areas.

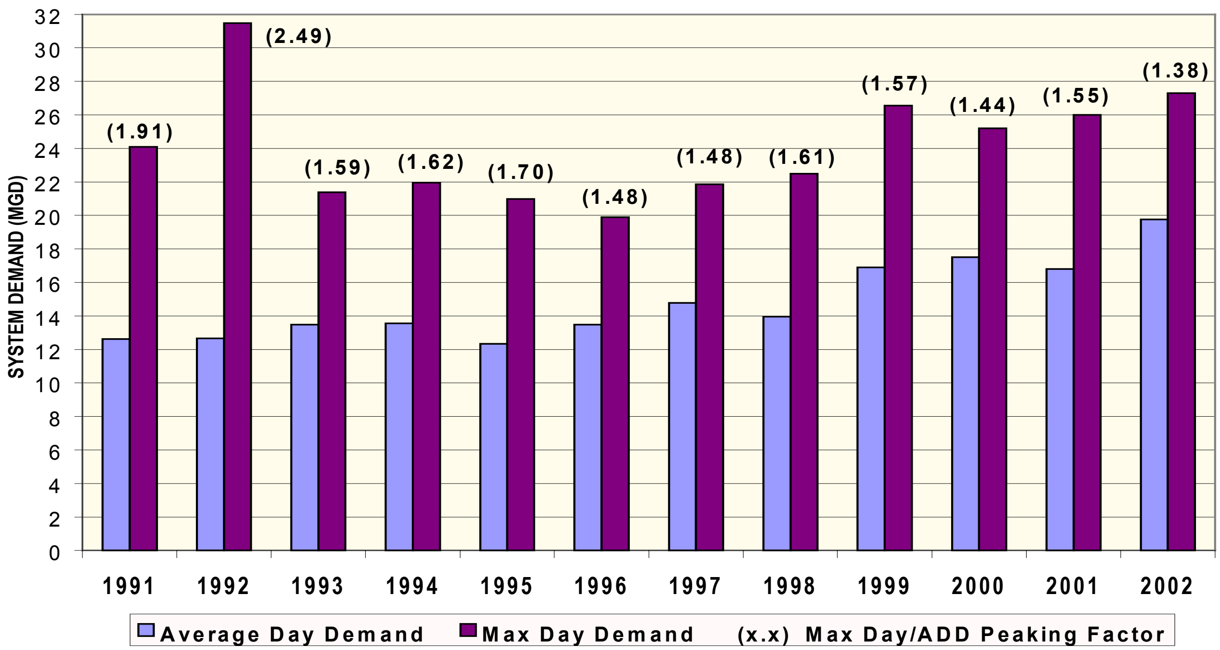
4.1 HISTORICAL WATER CONSUMPTION

Historical water consumption for the CMWD potable water system over the past eleven years is graphically illustrated on Figure 4-1. The consumption data was obtained from CMWD production reports, and is based on the water supplied from the SDCWA plus any net gain or loss in the volume of water in Maerkle Dam. Both the average annual and maximum day delivery rates are shown as well as the maximum/average ratio for each year. This ratio, which is referred to as the maximum day peaking factor, is used to size distribution system facilities.

There has been a gradual increase in the average annual water consumption rate from 12.6 MGD in 1991 to 16.8 MGD in 2001. This is approximately a 30 percent increase, or an average annual increase in the water demand of approximately 3.0 percent. In 2002 the average consumption rate increased to 19.7, primarily due to high winter demands resulting from a lack of rainfall. The maximum 24-hour flow rate delivered over the past eleven years is more varied, ranging from 31 MGD in 1992 down to 20 MGD in 1996 and back up to 27.3 MGD in 2002. With the exception of 1991 and 1992, the maximum day peaking factor has ranged between approximately 1.4 and 1.7 for the past decade.

The historical water usage reflects the decrease in potable water irrigation demands due to the start-up of the CMWD Recycled Water System. The CMWD began delivery of recycled water in the fall of 1991. Construction of the Phase I Recycled Water System is now complete, and deliveries from this system have steadily increased to approximately 1.9 MGD in fiscal year 200-2001. The recycled water deliveries include approximately 0.36 MGD of supplemental potable water supplied to the recycled water system at the "D" Tanks. It is noted that a portion of the existing irrigation demands currently served from the potable water system have been identified as future recycled water system customers when the Phase II Recycled Water System is constructed.

Figure 4-1
CMWD HISTORICAL DEMAND BASED ON SDCWA PURCHASES



4.2 EXISTING WATER CONSUMPTION

CMWD monthly water billing records for 2001 were obtained and analyzed to establish the existing water demands and distribute water demands in the distribution system hydraulic model. Raw data of the 2001 monthly billing records used to create the summary is available at the CMWD. The billing accounts were averaged over the 12-month period to determine the average day demand (ADD). For accounts with less than 12-months of service, the water usage was averaged over the number of months in service.

The CMWD identifies 12 categories of water users for billing purposes. For this Master Plan Update, several categories were combined and a summary of the resulting six demand categories is presented in Table 4-1. The number of customers and the total demand per account type in 2001 are shown in Table 4-2. The total average rate of water supplied for 2001 based on CMWD billing records is 16.2 MGD.

The total amount of water billed in 2001 does not exactly match the volume of water entering the distribution system. The difference between the SDCWA water purchased (and the gain/loss of stored water in Maerkle Dam), and the amount that is billed to CMWD customers is "unaccounted for" water. In most water distribution systems, the bulk of "unaccounted for" water is due to system leakage, meter inaccuracies, and unmetered water consumption from fire fighting, street cleaning, and construction uses. For the CMWD, the unaccounted for water in 2001 is calculated to be 221 MG, or an equivalent flow rate of 0.61 MGD. This is 3.6 percent of the total amount entering the distribution system. Water loss in the CMWD over the past ten years has typically been between two and five percent.

Table 4-1
WATER DEMAND CATEGORIES

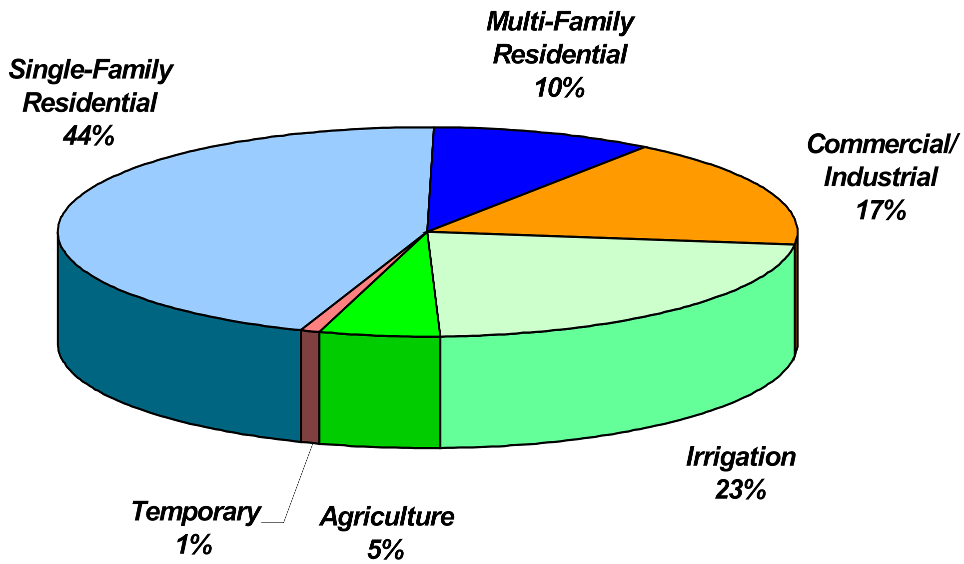
CATEGORY	BILLING RECORD METER TYPE
Single-Family	Single Family and Duplex accounts
Multi-Family	Multiple and Multiple PDU
Commercial/Industrial	Commercial (Commercial/Industrial) and Institutional
Agriculture	Includes Ag, Ag Rebate and Ag w/House account types
Irrigation	Irrigation
Temporary Potable	Temporary Potable and Fire Protection

Table 4-2
2001 WATER DEMAND BY CATEGORY

Category	No. of Accounts	% of Total	ADD (MGD)	% of Total	ADD per Account (GPD)
Single-Family	18,683	85.6%	7.22	44.7%	386
Multi-Family	662	3.0%	1.57	9.7%	2,371
Commerical/Industrial	1,185	5.4%	2.75	17.0%	2,321
Agriculture	42	0.2%	0.84	5.2%	19,999
Irrigation	681	3.1%	3.65	22.6%	5,359
Temp Potable	585	2.7%	0.13	0.8%	222
Totals:	**21,838**	**100%**	**16.2**	**100%**	

The percentage of the total system demand for each water use category based on the ADD is illustrated on Figure 4-2. As can be seen from the chart, residential water use accounts for 54 percent of the total water demand. Commercial/Industrial/Institutional water use and irrigation demands make up 17 and 23 percent, respectively, of the total water demand. It is noted that the irrigation demands do not include users supplied from the CMWD Recycled Water System, as recycled water users are identified with separate recycled water account types. However, supplemental potable water is supplied to the recycled water system during peak demand periods at the D Tanks. The supplemental potable water is delivered through an irrigation meter, and this demand is therefore included in the irrigation demands. Agricultural water demands currently account for approximately five percent of the total water use.

Figure 4-2
2001 WATER DEMAND BY CATEGORY



4.3 DEMANDS PER PRESSURE ZONE

CMWD water billing data for 2001 was used to determine the existing demand served within each pressure zone. The multi-step process used to generate this information involved the use of advanced GIS techniques, a graphical representation of each pressure zone, and water meter accounts that were assigned an Assessor Parcel Number (APN) by City staff.

The City parcel base map was used to locate the water accounts. The APN value from the billing information was matched to APN fields in the parcel GIS layer. City staff was not able to provide an APN for all the billing accounts. For accounts without APNs but with a street address, the address was used to approximate the account location by a process called geo-coding. A small percentage of billing accounts lacked either an APN or an address. These accounts were mostly irrigation or agriculture accounts. There were also accounts with both APNs and addresses that did not match up with the City parcel base. These accounts were found to be mostly in new developments. The accounts that could not be located using GIS techniques were sorted by demand. The 20 accounts with the highest demands were manually located based on consultation with the CMWD billing department. Of the 16.2 MGD of total system demand, 14.9 MGD or 92 percent of the demand was successfully located. The remaining 1.3

MGD of flow was distributed evenly over all the meter accounts to account for unlocated demands and match the total ADD for the system.

To assign meter account data to pressure zones, a pressure zone service area map was first created. The pressure zone map provided digitally from the last Master Plan was updated to reflect recent construction. The pressure zone service areas were then reviewed and corrected by City Operations staff. The existing demand per pressure zone, provided in Table 4-3, was created from an intersection of the pressure zone map and the modified billing accounts database.

Table 4-3
AVERAGE DAY DEMAND BY PRESSURE ZONE

Pressure Zone	Total Demand per Account Type (gpm)						Total Demand	
	SF	MF	Comm/ Indust	Irrig	Ag	Temp/ Fire flow	(gpm)	(MGD)
198	0	27	1	0	24	0	52	0.08
255	788	461	803	271	243	9	2,576	3.71
285	79	7	11	11	0	1	110	0.16
318	965	300	366	450	0	3	2,083	3.00
330	606	64	37	41	32	15	796	1.15
349	46	0	0	8	0	0	54	0.08
375	683	74	218	129	212	12	1,326	1.91
430	50	25	11	26	0	3	115	0.17
446	935	36	12	106	55	0	1,143	1.65
490	1	0	12	5	0	0	17	0.02
510	139	0	1	0	0	1	140	0.20
550	351	79	395	760	90	40	1,716	2.47
580N	231	0	1	49	0	0	281	0.41
580S	46	0	0	0	0	0	46	0.07
680	286	0	0	0	0	0	286	0.41
700N	186	31	42	235	0	3	498	0.72
700S	3	0	0	27	0	1	31	0.04
						Totals:	**11,272**	**16.23**

Note: *SF – single family residential*
MF – multi-family residential

4.4 EXISTING SYSTEM PEAKING

Water demands are typically presented in terms of the average annual water consumption. Actual water use, however, follows a widely varying pattern in which flows are sometimes well below or far greater than "average". Flow variations are commonly expressed in terms of peaking factors, which are multipliers to express the magnitude of variation from the average day demand (ADD). Peaking factors are commonly used to express the system maximum and minimum month demand, the maximum day demand (MDD), and the peak hour demand. The 2001 system demands are summarized in Table 4-4 and described in detail in the following sub-sections.

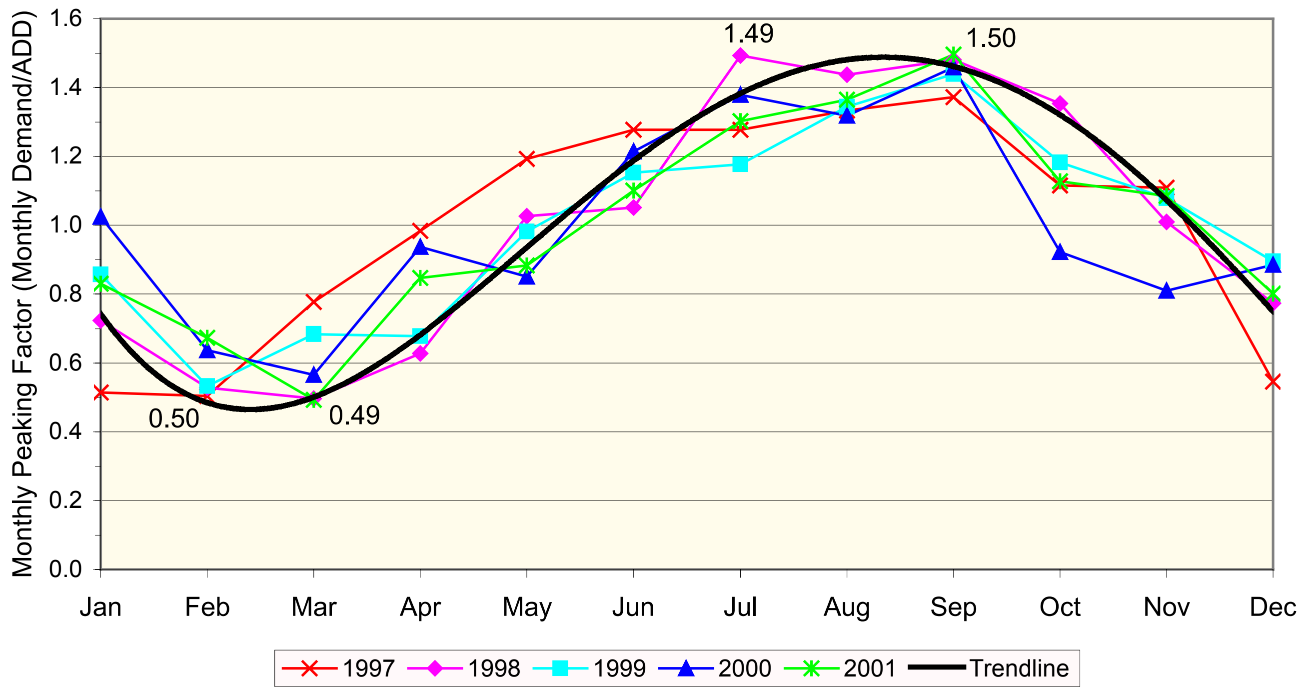
Table 4-4
SUMMARY OF 2001 SYSTEM DEMANDS

Average Day	16.2 MGD	25.1 CFS
Minimum Month	8.0 MGD	12.4 CFS
Maximum Month	23.0 MGD	35.6 CFS
Maximum Day	26.5 MGD	41.0 CFS
Peak Hour	46.6 MGD	72.1 CFS

4.4.1 Seasonal Demand Variations

CMWD water billing records were utilized to determine the seasonal variation in water demands. The monthly peaking based on billing records for the past five years is illustrated on Figure 4-3. Also included on this chart is a trendline of the data. From this chart it is apparent that the maximum month demand is approximately 1.5 times the average day demand, and the maximum water usage typically occurs in August or September. The minimum month demand is approximately half of the average day demand, and the minimum water usage typically occurs in February or March.

Figure 4-3
CMWD SEASONAL DEMAND VARIATIONS



4.4.2 Maximum Day Demand

The MDD represents the maximum consumption during any one day of the year. The maximum day peaking factor is expressed as a ratio of the maximum day demand divided by the ADD. The ratio generally ranges from 1.2 for very large water systems to 3.0 or even higher for specific small systems. For the CMWD, the single day with the maximum water consumption normally occurs during a dry, windy day between July and September.

Table 4-5 lists the day with the maximum water delivery and the amount of water delivered based on SDCWA purchase records over the past ten years. It is noted that the maximum water demand can only be approximated from water delivery records. The actual water consumption on a daily basis may not equal the water delivered, since the volume of water storage may not be the same at the start and the end of the day. As an example, the maximum day demand listed in Table 4-4 is higher than the recorded water purchase on July 27, 2001 based on the more detailed analysis in the following sub-section.

Table 4-5
HISTORICAL MAXIMUM DAY WATER PURCHASES

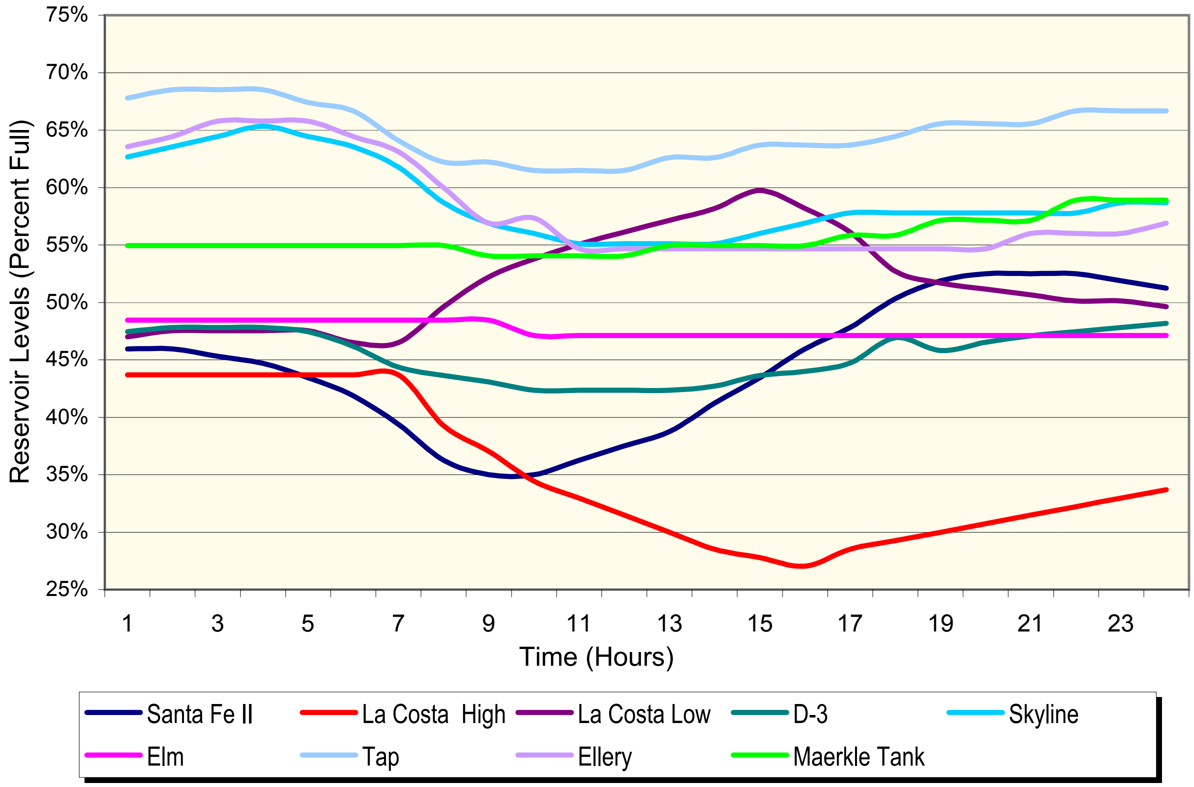
Year	Maximum Delivery Day	Water Delivered
2001	July 27	25.99 MG
2000	August 13	25.19 MG
1999	July 15	26.55 MG
1998	August 19	22.49 MG
1997	September 3	21.86 MG
1996	July 27	19.90 MG
1995	June 21	20.99 MG
1994	July 19	21.96 MG
1993	July 20	21.38 MG
1992	September 3	31.48 MG
1991	July 10	24.10 MG

The peaking factors corresponding to the maximum day demands listed above were shown previously in Figure 4-1 and ranged from approximately 1.5 to 1.7. Both the 1990 and 1997 Master Plans are based on a maximum day peaking factor of 1.65. This value is still representative of the peaking that has occurred over the past several years. For existing and future analysis of the distribution system, the same maximum day peaking factor of 1.65 will continue to be used.

4.4.3 Peak Hour Demand

The maximum flow rate delivered by the distribution system on any single hour during the year corresponds to the peak hour water demand. The peak hour peaking factor is the peak hour water demand divided by the ADD. Peak hour demands typically occur during the morning hours. To determine the peak hour demand in the CMWD system, two twenty-four hour periods with high water use were evaluated. Twenty-four hour demand curves were generated for July 27, 2001 and August 3, 2001 based on SDCWA delivery rates, the pumped supply rate from Maerkle Dam, and recorded reservoir levels. From the reservoir levels and tank dimensional data, the hourly volume of water entering or exiting each tank was calculated. The hourly system demand was then calculated based on the SDCWA delivery rate plus the total net flow rate into or out of the reservoirs (negative flow for tanks filling, positive flow for tanks emptying).

FIGURE 4-4
RESERVOIR LEVELS AND DIURNAL DEMAND CURVE FOR JULY 27, 2001



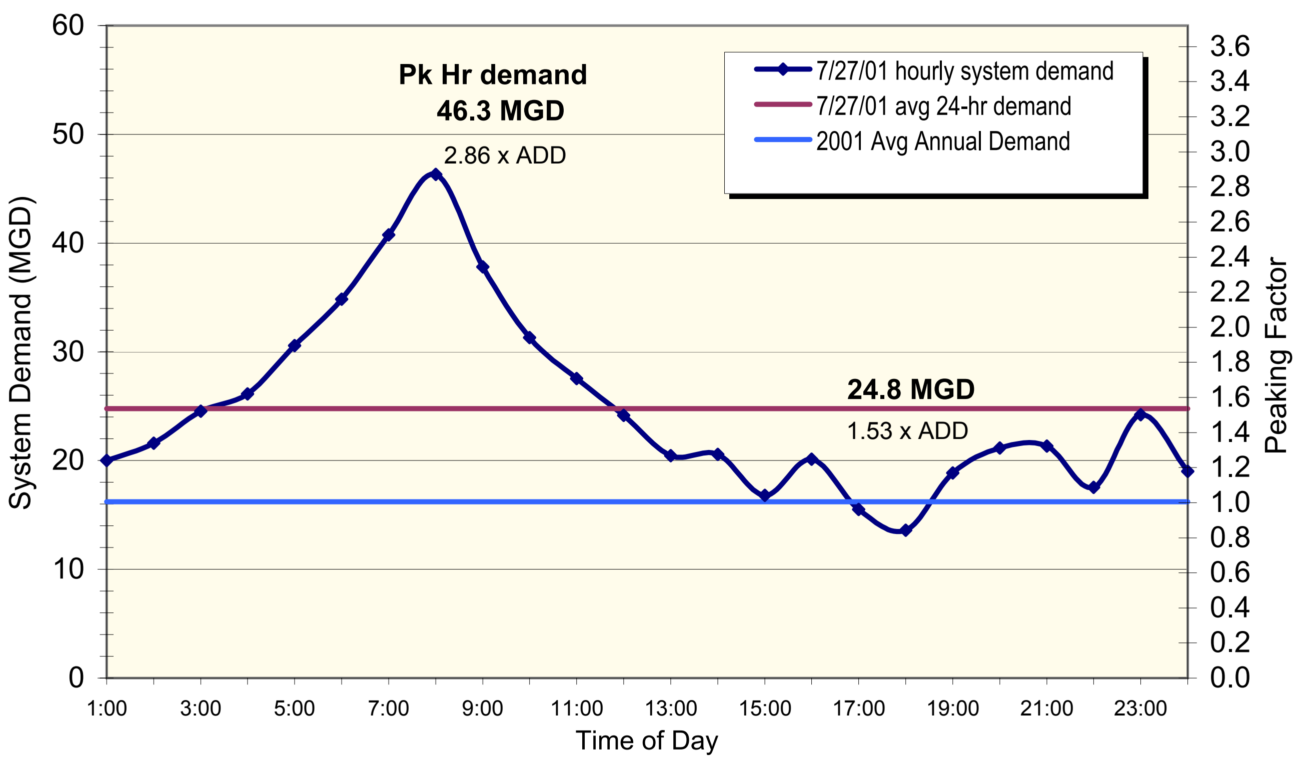
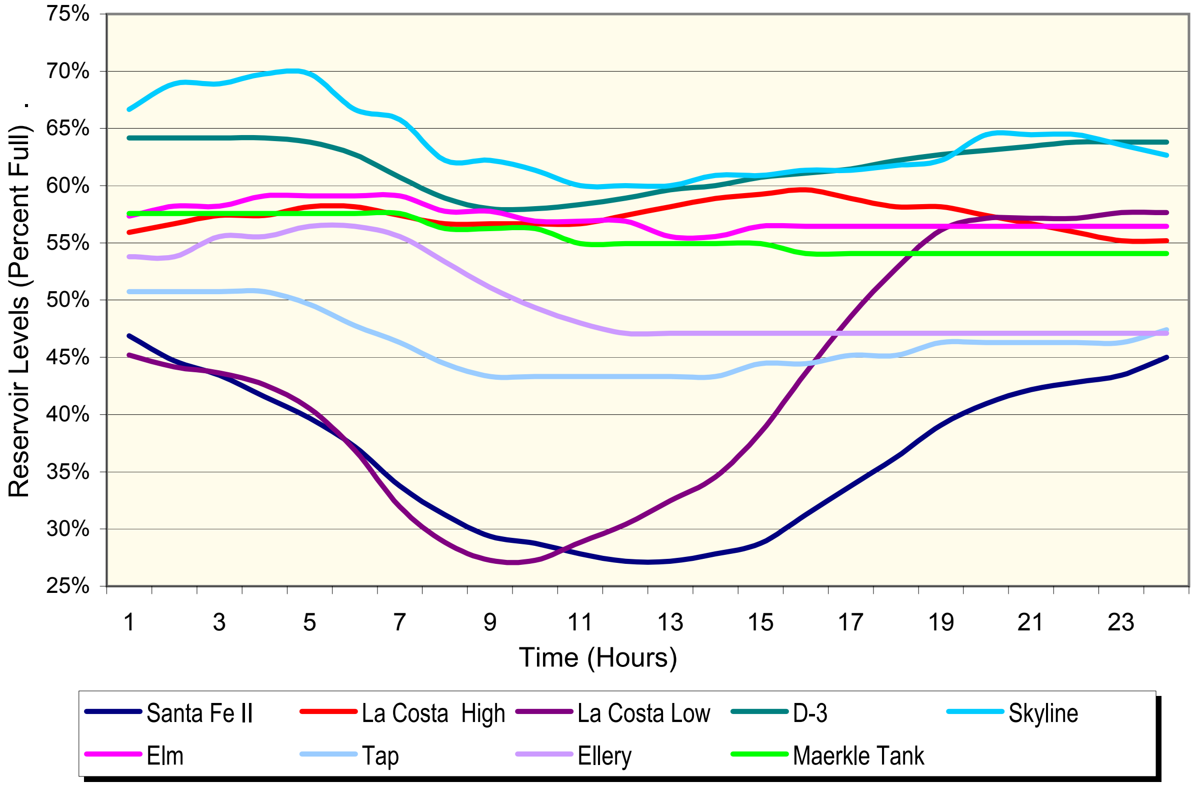
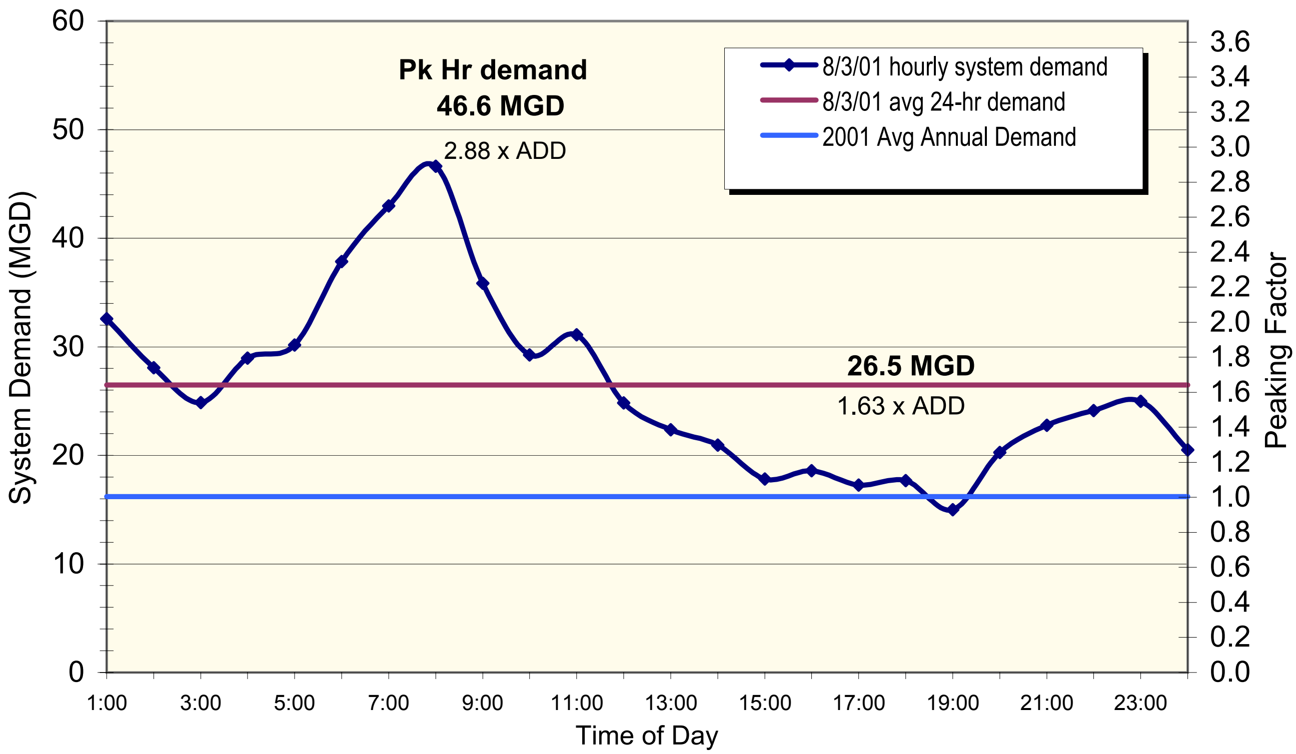


FIGURE 4-5
RESERVOIR LEVELS AND DIURNAL DEMAND CURVE FOR AUGUST 3, 2001





The reservoir levels and resulting demand curves for both days are shown on Figures 4-4 and 4-5. The peak hour demand on July 27th was calculated to be 46.3 MGD and the peak hour demand on August 3rd was 46.6 MGD. The corresponding peak hour peaking factors for these days are 2.86 and 2.88, respectively. The previous Master Plan used a peak hour factor of 2.5. Based on this recent data, a peak hour peaking factor of 2.9 is deemed more representative of the existing water system.

It is noted that demand curves for most water districts typically exhibit two peak demand periods, one during the mid-morning hours and a second, usually lower peak in the evening hours. The CMWD peaking curves for the days analyzed display a somewhat unusual pattern, exhibiting the typical large morning peak but no evening peak. Also, the average 24-hour demand on August 3rd was determined to be higher than the demand on July 27th, which was recorded as the maximum demand day based on the SDCWA supply rate. On July 27th the water purchased was 1.2 percent greater than the system demand, whereas on August 3rd the water purchased was 5.0 percent less than the demand.

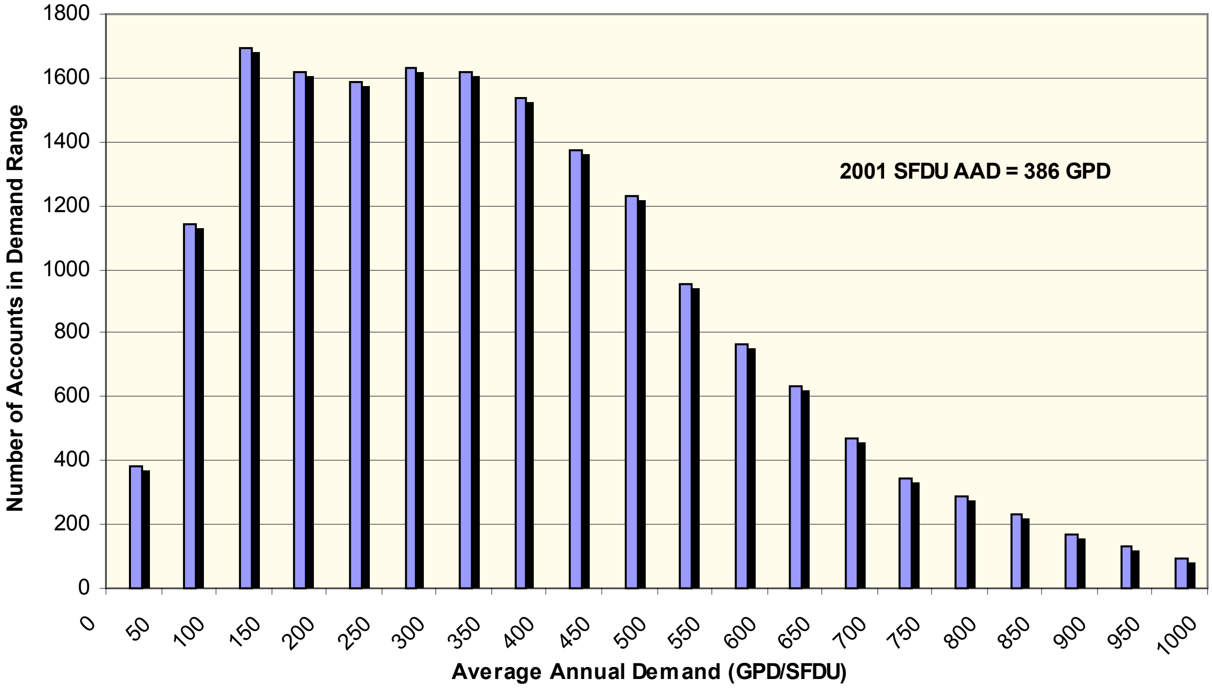
4.5 EXISTING UNIT DEMANDS

Ultimate water projections are made in this Master Plan Update based on information in the Carlsbad 2001 Growth Database. The Growth Database identifies the number of future single-family and multi-family residential units and the square footage of future non-residential buildings. Demand generation factors based on existing conditions are determined in the following sub-sections to develop unit water demands for ultimate flow projections.

4.5.1 Single-Family Residential Demands

The water demand for single-family residences is comprised of an indoor water use component and an irrigation component. From Table 4-2 the average demand based on 2001 billing data for single-family dueling units is calculated at 386 gallons per day (gpd). Using the 2001 billing data, a bell-curve (normal distribution) graph was prepared to evaluate the range of existing residential demands. Figure 4-6 illustrates the number of existing residential customers with average demands in 50 gpd increments. As can be seen from this bar chart, there is a wide distribution of average demands in excess of the average demand, which is due in part to the high variation in the irrigation demand component. A residential unit water demand of 576 gallons per day per equivalent dwelling unit (gpd/EDU) was used in the previous Master Plan for projecting water system demands.

Figure 4-6
DEMAND DISTRIBUTION FOR SINGLE FAMILY RESIDENTIAL ACCOUNTS



4.5.2 Multi-Family Residential Demands

Apartments and public dwelling units are billed are assigned multi-family billing accounts. There is typically one meter for each separate building comprising an apartment complex. Newer developments have separate irrigation meters for common areas. In older or very small complexes, there may be only a single multi-family meter. Water records for 2001 were analyzed for two larger complexes to determine the average unit demand per multi-family unit. The water demand of the associated irrigation meters and clubhouse facilities (commercial meter) were included in the total demand, so that the unit demand represents both domestic and irrigation water use.

The multi-family developments analyzed were a low-income housing project consisting of 344 units north of Cassia Road, and a 585-unit apartment complex known as Tanglewood. The average water demands per unit for these complexes based on 2001 billings records are 155 gpd and 228 gpd, respectively. The previous Master Plan used a multi-family unit demand of 144 gpd/EDU for planning purposes. Based on this updated analysis, a higher unit demand is justified.

4.5.3 Industrial/Commercial Demands

An investigation was conducted to determine a representative unit water demand per building area for industrial business park developments. The sewer service area of the Faraday Upper Lift Station was analyzed as part of the Sewer Master Plan Update, and this same service area was used to determine the average unit water demand. The Faraday Upper Lift Station service area is known as the Faraday Business Park, and consists primarily of office and light industrial uses, with a few commercial establishments. There are no residential units in the service area.

Consistent with the analysis performed for the sewer system, water records from July 2001 through February 2002 were obtained from the CMWD accounting department staff and reviewed. The Faraday Business Park is not yet fully developed, and there are numerous buildings within the study area that are vacant or only minimally occupied. Water records from August 2001 were reviewed in detail, and only parcels with water usage from commercial meter accounts were included in the analysis. The occupancy of buildings with low water usage was verified by visual observation, and corresponding information on the building area and parcel size was obtained from the City's Growth Database. Each parcel typically has separate accounts for commercial, irrigation, and fire protection meters. Eighty-one parcels were included in the analysis with 93 corresponding commercial water accounts (some parcels have more than one water meter). Demands from irrigation meters for streetscaping, which have an address but no associated APN, were also included in the analysis.

A summary of the Faraday Business Park demand data is provided in Table 4-6. In August 2001, the total commercial demand was approximately equal to the irrigation demand within the study area. Water demands for the commercial accounts were highly variable, and the interior water use was generally less than the on-site irrigation water use. However, the interior water use for Callaway Golf at 2180 Rutherford Road significantly increased the commercial account totals. Water delivered to the two active commercial meters on this parcel amounted to 27 percent of the total water use in the study area for August 2001. The variance in water usage from commercial and irrigation meters over the seven-month period analyzed is shown on Figure 4-7.

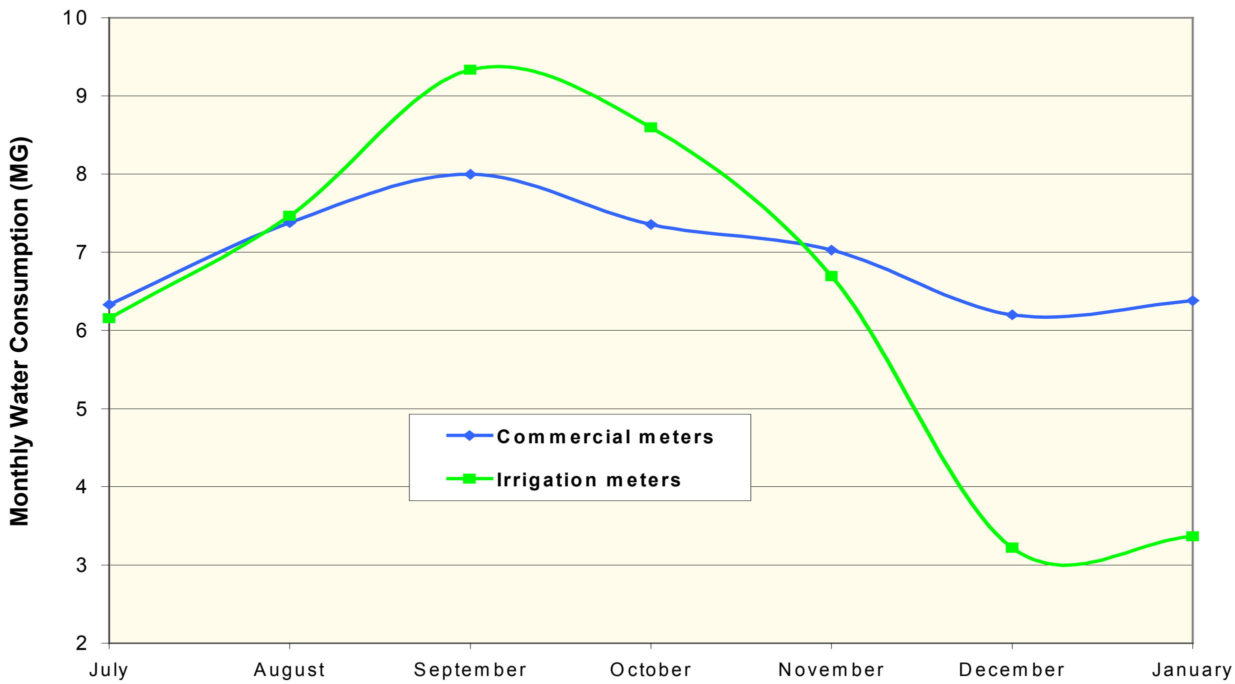
The unit water demand for the Faraday service, area based on the building size, was determined to be 1,200 gpd per 10,000 square feet (sqft) of building area. The previous Master Plan used unit demand factors based on the lot size, and the industrial unit demand was 2,160 gpd per acre. The unit demand based on lot size for the Faraday area is calculated to be 1,529 gpd per acre.

Table 4-6
SUMMARY OF FARADAY INDUSTRIAL PARK ANALYSIS

Total Water Consumption in August 2001	-	19,840	HCF
Total from Commercial meters	-	*9,863*	*HCF*
Total from on-site Irrigation meters	-	*8,448*	*HCF*
Total from streetscape Irrigation meters	-	*1,529*	*HCF*
Total Water Consumption in August 2001	-	14.8	MG
Total Area of Included Parcels	-	313	acres
Total Building Area	-	3,990,514	sqft
Total Building Area	-	92	acres
Average Building Coverage	-	29%	of parcel area
August 2001 Unit Water Consumption	-	3.72	gal/building sqft
Unit water demand	-	1,200	gpd/10,000 sqft
Unit water demand	-	0.83	gpm/10,000 sqft
Unit water demand	-	1,529	gpd/acre

Note: HFC – hundred cubic feet

Figure 4-7
FARADAY BUSINESS PARK 2001-2002 MONTHLY WATER CONSUMPTION



In addition to the Faraday Business Park, water demands for restaurants were also investigated. Commercial water accounts for five restaurants on Avenida Encinas were analyzed together with data on the building size. The average unit water demand for the restaurants is estimated at 4.9 gpm per 10,000 square feet of building area. This is approximately six times higher than the calculated industrial unit demand for the Faraday Business Park.

CHAPTER 5
EXISTING SYSTEM EVALUATION

The level of service that is provided to a community is the result of the implementation of improvements that are "designed" in accordance with accepted criteria. The performance of a water distribution system and its components are evaluated based on comparisons with established and verified planning criteria. This chapter describes the planning criteria, analysis methodology, hydraulic computer model and results of the hydraulic system analyses used in the evaluation of the water distribution system relative to 2001 conditions. The hydraulic analysis employs the use of the $H_2ONet^{®}$ hydraulic modeling software. System deficiencies are identified and recommended projects to mitigate or eliminate the deficiencies are presented in Chapter 7, Recommended Capital Improvement Projects.

5.1 PLANNING CRITERIA

The planning criteria for the evaluation of potable water facilities in the CMWD are based on existing system performance characteristics, past criteria used by the District and current industry and area standards. Planning criteria include standards for demand peaking factors, pressure zones, pipelines, fire flows, and storage reservoirs. A summary of criteria that impact the design of water facilities is provided in Table 5-1. These criteria, which are discussed in detail in this section, are the basis for evaluating water system performance and determining facilities required to serve future development.

5.1.1 Demand Peaking Factors

The demand peaking factors are based on an analysis of current and historical CMWD peak flows, as described in detail in the previous chapter (Section 4.4- Existing System Peaking). The minimum and maximum month peaking factors of 0.5 and 1.5, respectively, are documented for the first time in this report. A maximum day peaking factor of 1.65 and peak hour factor of 2.5 were used in the previous Master Plans. The peak hour factor has been revised upward from 2.5 to 2.9 based on an analysis of hourly demand data from August 2001 (as discussed in Section 4.4.3 of this report).

5.1.2 System Pressures

The range of water pressures experienced at any location is a function of the hydraulic grade and the service elevation. Within a specific pressure zone, the hydraulic grade is affected by the reservoir water level, pressure reducing valve setting, and friction losses in the distribution system. The maximum static

Table 5-1
CMWD PLANNING AND PERFORMANCE CRITERIA SUMMARY

WATER DEMAND PEAKING FACTORS	0.5 x ADD – Minimum Month Demand 1.5 x ADD – Maximum Month Demand 1.65 x ADD – Maximum Day Demand 2.9 x ADD – Peak Hour Demand
SYSTEM PRESSURES	Static Pressures (based on the reservoir HWL): 60 psi – minimum desired 125 psi – maximum desired 150 psi – maximum allowed Dynamic Pressures (with reservoir levels half full): 40 psi – minimum allowable pressure during peak hour demands 20 psi – minimum allowable pressure for fire flows 25 psi –-maximum desired pressure drop from static pressures
PIPELINES	8 fps – maximum allowable velocity at peak hour flow 5 ft./1000 ft – maximum desirable head loss at peak flow 10 ft./1000 ft – maximum allowable head loss at peak flow Dead-end water lines are to serve no more than 18 residences
FIRE FLOWS	Single-Family residential – 1,500 gpm for 2 hours Multi-Family residential – 3,000 gpm for 2 hours Industrial/Commercial/Institutional – 4,000 gpm for 4 hours
DAILY STORAGE	Storage capacity in the distribution system equal to the total of the following based on the reservoir service area: Operational – 15% of Maximum Day Demand Reserve – 100% of the Maximum May Demand Fire Flow – Maximum fire flow for the required duration
EMERGENCY STORAGE	10 days of storage based on the ADD *Emergency storage is contained in the Maerkle Dam*

pressure within a pressure zone is based on the high-water level of the reservoir or highest pressure reducing valve setting and the elevation at any specific point in the zone. The maximum desired pressure is 125 psi and the absolute maximum pressure should be no greater than 150 psi. These criteria enable Class 150 water pipe, the most common class of pressure pipe, to be used in the distribution system. The minimum static pressure is used as a general guideline for initial design efforts, as the operating or dynamic pressures will generally be lower.

The minimum allowable pressure is 40 psi under peak hour flow conditions and 20 psi at a fire flow location during a fire occurring under maximum day demand conditions. Under certain circumstances, the CMWD will approve the installation of private pumps for areas that receive less than the minimum 40 psi operating pressure. The minimum pressure in the distribution system for these areas must be 20 psi based on the Health Department guidelines and the ability to provide adequate pressures for fire flows.

5.1.3 Pipelines

Criteria for pipeline sizing is based on keeping velocities low to minimize wear on valves and scouring of interior coatings, and limit head loss in the distribution system. Water distribution mains should be designed to supply peak flows at velocities below eight feet per second, and the corresponding head loss should not exceed ten feet per 1000 feet. These criteria may be exceeded during fire flow situations or in areas where there is a large safety factor in meeting pressure criteria. Generally, transmission mains are designed based on peak flows and reservoir filling conditions, while distribution piping is sized for fire flows. For zones with long transmission mains, the pipeline friction loss will typically need to be less than 3 to 5 feet per 1000 feet to maintain adequate pressures and minimize pressure swings. Looping is highly desirable in a distribution system and long, dead-ended pipelines should be avoided where possible due to reliability and water quality concerns.

5.1.4 Fire Flow Requirements

Water must be available not only for domestic and agricultural use, but also for emergency fire fighting situations. This type of water use is called a fire flow, and the fire flow must be sustainable for a specific duration at a minimum pressure of 20 psi. General standards establishing the amount of water for fire protection purposes are set by the Insurance Services Office (ISO), and these general standards are applied by local jurisdictions such as the CMWD and the Carlsbad Fire Department. The considerations such as type of occupancy, type of construction and construction materials, distance from other structures, and other factors can be considered when assigning fire flow requirements.

In lieu of calculating specific fire flows for individual structures, the Carlsbad Fire Department has established minimum fire flows for general building categories. The fire flows listed in Table 5-1 were reviewed and approved by the Carlsbad Fire Department as part of this Master Plan Update. A minimum fire flow of 1,500 gpm is required for single-family and duplex residential units. A 3,000 gpm multi-family residential fire flow applies to buildings consisting of four or more residential dwelling units. A 4,000 gpm fire flow is required for commercial, industrial, office and institutional buildings, including schools. The Fire Department may require higher fire flows under certain circumstances, such as developments adjacent to open space areas susceptible to wild fires or buildings with floor areas in excess of 300,000 sqft.

5.1.5 Storage Criteria

Water storage is used to supply peak hourly fluctuations (operational storage), make up the difference between the amount of water ordered and consumed, provide fire flows, and supply the service area in the event of a planned facility shutdown or emergency situation. Storage reservoirs should be provided separately in each zone when possible, or if necessary, in a higher pressure zone. The 1997 Master Plan identified specific storage criteria which, at the direction of CMWD Staff, is used in the Master Plan Update. Storage within the distribution system reservoirs is termed “daily” storage. The required volume for daily storage is calculated as the sum of operational, fire flow and reserve storage based on the demands and land use within the reservoir service area. Emergency storage for the CMWD is provided in Maerkle Dam.

<u>Operational Storage</u>

Water is supplied to the CMWD distribution system from the SDCWA at a constant supply rate, which is the projected water use for the following 24-hour period. Peak hour demands in excess of the 24-hour average demand must be satisfied by drawing on water stored in the CMWD water storage reservoirs. Providing operational storage within a zone allows transmission mains to be sized for maximum day demands, rather than higher peak hour flows. The operational storage required is the volume above the maximum day average flow rate. For the two high demand days evaluated in August 2001 (refer to Chapter 4, Section 4.4.3) the volume of water supplied from the reservoirs was 12 percent and 13 percent of the average 24-hour demand on these days. An operational storage requirement of 15 percent of the maximum day demand has been used for the CMWD.

<u>Reserve Storage</u>

Reserve storage provides water during incidents such as pipeline failures, pumping or equipment failures, electrical power failures, and natural disasters. In the operation of the CMWD system, reserve storage is also used for daily operations. A reserve storage requirement of 100 percent of the maximum day demand has been allocated for these purposes.

Fire Flow Storage

Each reservoir serving the CMWD must be able to supply enough water to extinguish the worst case fire that is likely to occur within its service area. Fire flow storage is equal to the volume of water required for the largest fire flow requirement within the reservoir service area, as determined by the land use. For zones with multiple storage reservoirs, the required fire flow storage may be divided between the reservoirs. In addition, when one reservoir supplies a very large service area or more than one major pressure zone, the fire flow storage for that reservoir may be increased based on the probability of simultaneous fires within the service area.

Emergency Storage

The SDCWA recommends maintaining a total storage capacity equal to ten times the average day usage. The City of Carlsbad has also adopted a policy of providing a minimum 10 day average storage capacity in the 1986 Citywide Facilities and Improvements Plan.

5.2 HYDRAULIC MODEL DEVELOPMENT

Analysis of the water distribution system is performed using the H_2ONET® modeling, analysis and design software developed by MWH Soft, Inc. H_2ONET® provides a computer aided design (CAD) interface for building and editing model facilities, and a hydraulic analysis engine to perform extended period simulations. An H_2ONET® hydraulic computer model was developed for the CMWD in 1997 as part of the 1997 Water Master Plan Update. This model was calibrated to 1997 conditions. In 1999, the model was updated with pipelines for developments between 1997 and 1999. For this current Master Plan Update, the 1999 model has been updated and enhanced to represent the 2001 water distribution system. The 1999 model was converted to NAD 83 coordinates and overlaid on the City's parcel map. Pipeline alignments were visually adjusted as necessary. The 2001 existing system hydraulic model with pipelines colored coded by diameter is illustrated on Figure 5-1.

5.2.1 Physical Data Input

The hydraulic model is made up of pipes, junction nodes, valves, tanks and pumps. Pipeline inputs consist of the alignment, length, diameter, construction year, pipeline material, and a roughness coefficient. The function of the roughness coefficient, which is also known as the Hazen Williams "C" coefficient, is to estimate system friction losses. The "C" coefficient has been assigned based on both the pipeline age and material type, and values in the model range from 80 to 145. Node inputs consist of the demand, a fire flow requirement, and the elevation. For the recent pipeline projects added to the model in this update, the elevation was obtained from construction drawings.

Proper modeling of valves in the CMWD hydraulic model is essential for an accurate representation of the distribution system. For this Master Plan Update, the location of isolation valves that separate pressure zones were reviewed and re-located based on input from CMWD Operations Staff. The flow and pressure regulating valves in the previous model were also removed and new valves were input based on 2001 conditions. Flow input from the SDCWA connections is modeled with flow control valves. Flow to the 15 separate pressure zones in the model is regulated by over 40 pressure control valves, with control settings as documented in Table 3-5. For pressure reducing and/or sustaining stations with multiple valves, the largest valve size is typically modeled. The primary pressure reducing station for each zone is typically modeled with a combination pressure reducing/sustaining valve, with control logic to determine the active mode of operation. Secondary pressure reducing stations or those used primarily under emergency/fire flow conditions are generally modeled with a single pressure reducing valve. Flow control valves are used to regulate flow through the Maerkle Control Vault and to the D3 Reservoir.

5.2.2 Demand Input

System demands are input to the model at junction nodes. For this Master Plan Update, new demands were input to the existing system model based on 2001 water billing records. The process of importing the billing data was performed using GIS techniques.

To input meter account data into the model, a copy of the model nodes was initially exported from the hydraulic model and input into the GIS software. A routine was then enacted to link the adjusted 2001 billing data, spatially located to the City's parcel base, to the nearest model node. The demand at each model node is therefore a sum of the water billing data from various account types on the surrounding parcels. Prior to exporting the nodes, the model was reviewed and a number of nodes were assigned as "no-demand" nodes. This additional step was necessary for locations where a transmission main for one pressure zone extends through a service area for a different pressure zone. In this case, the accounts on the surrounding parcels are assigned to the distribution pipelines in the correct service zone, and not the transmission main, which serves no demands.

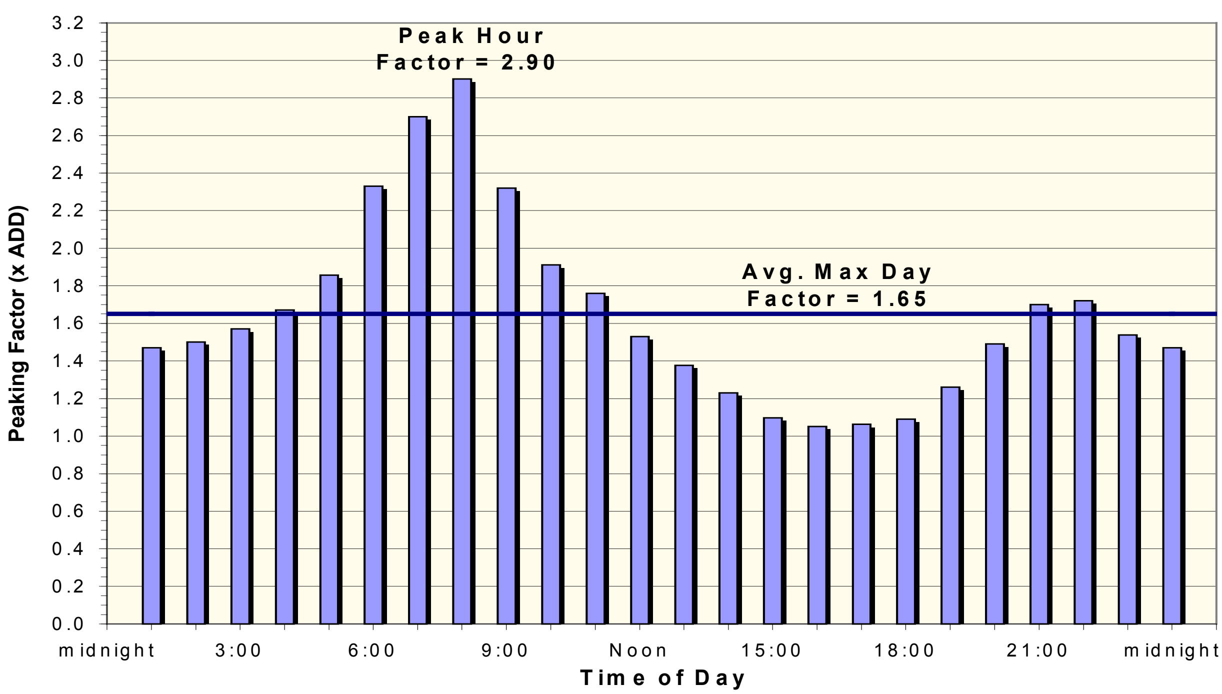
As the billing account data is linked to the model nodes, the meter types are also analyzed to determine fire flow requirements. For model nodes where all the linked accounts are single-family or duplex accounts, a residential fire flow is assigned to the model node. If one or more multi-family accounts are assigned to a given model node, the node is assigned with a multi-family fire flow. Likewise, if a commercial or industrial account is included, the node is labeled commercial/industrial, and assigned a higher fire flow. The fire flow assigned to each node is therefor based on the included account type with the highest fire flow requirement. After model nodes were successfully assigned average day demands based on billing account information, the nodes were imported back into the hydraulic modeling program.

5.3 MAXIMUM DAY DEMAND 24-HOUR SIMULATION

The analysis engine of the H_2ONET® hydraulic modeling software solves the hydraulic model by using the “Gradient Algorithm Hybrid Method” developed by EPANET. EPANET is a hydraulic and water quality analysis program developed by the Water Supply and Water Resources Division of the U.S. Environmental Protection Agency's National Risk Management Research Laboratory. The analysis method solves a system of linear equations in an iterative process using matrix techniques. H_2ONET® performs extended period simulations (EPS) to route water flows through the system using diurnal demand curves. The result of this analysis technique is a balancing of reservoir flows and a more accurate system response to changing demands within the subject distribution system.

To assess performance of the existing distribution system, system demands corresponding to a maximum demand day were developed and input to the existing system model. The representative 24-hour maximum day peaking curve for the CMWD, based on the flow analysis of two high demand days (presented in Chapter 4) and the maximum demand day curve used in the 1997 model, is shown on Figure 5-2. Based on this representative curve and an existing system ADD of 16.2 MGD, the maximum day 24-hour demand analyzed is 26.7 MGD, and the peak hour demand is 47.0 MGD.

Figure 5-2
MAXIMUM DAY DEMAND PEAKING FACTOR CURVE



Input flow to the distribution system model was set equal to the maximum day demand rate (26.7 MGD) and proportioned between the four SDCWA connections based on typical summer flows. Reservoir water levels were initially set at half full. No pump stations were activated, and flow from the 550 Zone to the 375 Zone at the D3 Reservoir (through the throttled plug valve) was set at 2,000 gpm. An extended period simulation was then run to assess reservoir performance (the ability to supply peak flows and refill after draining). Several simulation iterations were required to properly adjust the SDCWA inflows and distribution system valves with variable settings. After the final flow adjustments were made, reservoir levels were maintained between 25-75 percent full during the 24-hour simulation with maximum day demands. The SDCWA inflows modeled at the aqueduct connections are shown in Table 5-2.

Table 5-2
INFLOW FOR THE MAXIMUM DEMAND DAY SIMULATION

SDCWA Connection	Diameter (in.)	Flow Control Setting	
		(MGD)	(CFS)
CWA #1	27	12.93	20.01
CWA #2	27	4.86	7.52
TAP #3	21	4.84	7.49
TAP #4	24	4.09	6.33
	Total:	26.73	41.35

Results of the 24-hour simulation were reviewed and analyzed. Model pressures were sorted to determine both high and low pressure areas. During the peak hour demand (hour eight of the simulation) pressures and pipeline velocities were plotted. The following observations were noted:

– The model indicates a pressure of less than 30 psi in the 680 Zone on Obelisco Court, which has an elevation of 585 feet in the model. The static pressure at this location is 41 psi based on a 680 Zone, however the pressure setting and PRV elevation provided by Operations Staff for the Alga Road PRV #1 Station result in a grade of only 657 feet for this zone. The low pressure is the result of the high elevation (which may be incorrect in the model), and the low PRV setting.

– Low pressures (low 30's) were observed near the 330 Zone in the vicinity of the Elm Reservoir. The low pressures are the result of high elevations, which are approximately 255 feet in this area.

– High pressures (175-185psi) are indicated in the 490 Zone transmission main in El Camino Real near Jackspar , where the elevations in the model drop below 200 feet.

- High pressures (140-160 psi) are indicated along an 8-inch diameter pipeline in Paseo Cerro, located between Melrose Drive and the CMWD boundary in the 700N Zone. Elevations in the model along the length of this pipeline are 350 feet.

5.4 FIRE FLOW ANALYSIS

A fire flow analysis was performed on the existing system hydraulic model to determine the fire flow capacity at each node. Results from the H_2ONET® fire flow simulation include the dynamic pressure at each demand node while delivering the required fire flow and the available fire flow at each node with a 20 psi residual pressure. The fire flow simulation was run with maximum day demands (ADD x 1.65) and the water level at reservoirs set to half full. The available fire flow was compared to the required fire flow based on the meter account type (1,500 gpm for single-family, 3,000 gpm for multi-family, or 4,000 gpm for commercial/industrial), and deficiencies were identified.

Initially, over 40 nodes were identified that could not deliver the required fire flow. These node locations were each evaluated and compared to the location of fire hydrants based on the CMWD atlas maps. At many locations, modifications were made to the model to more accurately represent the existing system. The modifications included removing a fire flow from pipelines that do not serve hydrants, relocating nodes to match hydrant locations, or making minor pressure zone boundary adjustments. Many of the nodes with substandard commercial fire flows were located at on-site pipelines extending through a commercial property. A 4,000 gpm commercial fire flow is typically provided from a combination of two or more hydrants. At several nodes the required fire flow was therefore modified to represent delivery of a commercial fire flow from a combination of hydrants. Clubhouse facilities and recreation centers for private residential developments are typically provided with commercial meters. Based on discussions with the City of Carlsbad Deputy Fire Marshall, however, a commercial fire flow is not required for these facilities. The required fire flow was reduced for identified clubhouse and recreation facilities based on the type of existing residential development.

After modifications were made to the fire flow model, the simulation was re-run. Results indicated that seven nodes could not provide a residential fire flow of 1,500 gpm at a minimum pressure of 20 psi. Four demand nodes could not provide the required multi-family fire flow of 3,000 gpm, and three demand nodes could not provide a commercial/industrial fire flow of 4,000 gpm with a minimum 20 psi residual pressure. A summary table of the deficient fire flow nodes is provided in Table 5-3. Capital Improvements projects to increase the available fire flow for the projects listed in Table 5-3 are identified in Chapter 7 of this report.

TABLE 5-3
LOCATIONS WITH REDUCED FIRE FLOW CAPACITIES

Model Node	Location	Model Elevation (ft)	Required Fire Flow (gpm)	Available Fire Flow from Model (gpm)
440	Glasgow Dr. - Calavera Hills Recreation Center	354	4,000	*
2460	Garfield St. and Olive Av. (Hubbs Institute)	47	4,000	3,132
2825	Church at Flores Dr and Forest	177	4,000	3,418
2750	West end of Cynthia Drive	130	3,000	1,055
1310	South end of Holly Brae Lane	286	3,000	1,247
1080	South end of Cove Drive	21	3,000	1,377
2185	Chestnut Ave to Woodland Way and Cul-de-sac	127	3,000	1,756
7125	Obelisco Court	585	1,500	522
2210	Cul-de-sac at end of Jeanne Place	168	1,500	729
2300	Highland Dr south of Hillside Drive	118	1,500	924
2055	Cul-de-sac at end of Falcon Drive	290	1,500	1,036
2060	Cul-de-sac at end of Nob Hill Drive	283	1,500	1,077
2875	Highland Dr. and Ratcliff Road	155	1,500	1,209
2225	Cul-de-sac at Adair Way	127	1,500	1,337

* Available fire flow is based on the delivery rate through the CWA TAP No. 4 connection.

Analysis results indicate that the majority of substandard residential fire flows are caused by excessive headloss through a single 6-inch diameter pipeline upstream of the fire flow location. In the 580N Zone, which does not have storage and is supplied directly from the TAP No. 4 Connection, a 4,000 gpm commercial fire flow would not be available to the City of Carlsbad Calavera Recreation Center under most supply conditions. The Calavera Hills emergency pump station can provide a supplemental flow of 1,500 gpm to this zone, but the total available fire flow may not be adequate during winter months, when lower flow rates are ordered at the SDCWA TAP No. 4 Connection.

It is noted that the available fire flow rate from H_2ONET® simulation results should be interpreted only as an approximation. The actual flow rate available from any given fire hydrant with a 20 psi residual pressure is dependent on the exact location, elevation, and type of fire hydrant, and also the physical condition (and resulting friction loss) of the upstream pipelines. An elevation difference of ten feet in the model can significantly effect the reported available fire flow. The CMWD may therefore want to conduct hydrant flow tests at the locations identified in Table 5-3 to confirm the model results. It is also noted that many of the existing smaller, dead-end pipelines are not included in the hydraulic model. Specifically, there are a number of older 4-inch diameter pipelines with warf-head hydrants that cannot provide the minimum flow rate for fighting fires. The locations identified from the model as having reduced fire flow capacities are therefore only a partial list of fire flow deficiencies in the entire distribution system.

5.5 STORAGE ANALYSIS

The required storage volume based the criteria defined in Table 5-1 and 2001 demands was calculated and compared to the capacity of the existing system reservoirs, as discussed below.

5.5.1 Daily Storage

Daily storage is provided in distribution system reservoirs. To determine the required storage volume, the service area for each reservoir is defined and the corresponding demand calculated from 2001 meter accounts. Calculations to determine the required storage volume are shown in Table 5-4. Based on these calculations, there is approximately 12.5 million gallons (MG) of excess storage capacity in the existing system. However, on a zone-by-zone basis the 318 and 255 Zones are currently deficient in storage.

Table 5-4
EXISTING DAILY STORAGE REQUIREMENTS

RESERVOIR	Service Zones	Existing Demand		Storage Requirements				Reservoir Capacity	Surplus/ Deficit
		ADD (MGD)	MDD (MGD)	Operational (.15 x MDD)	Fire Flow(1)	Reserve (1 MDD)	Total		
La Costa High	700S 680 580S 510	0.04 0.41 0.07 0.20	0.07 0.68 0.12 0.33	0.2 MG	0.96 MG	1.2 MG	2.3 MG	6.0 MG	3.7 MG
Santa Fe II	700N 550 430	0.72 2.47 0.17	1.19 4.08 0.28	0.8 MG	0.96 MG	5.5 MG	7.3 MG	9.0 MG	1.7 MG
Maerkle Res.	490 285 198	0.02 0.16 0.08	0.03 0.26 0.14	0.1 MG	0.96 MG	0.4 MG	1.5 MG	10.0 MG	8.5 MG
TAP	580(2) 446 349	0.41 1.65 0.08	0.68 2.72 0.13	0.5 MG	0.96 MG	3.5 MG	5.0 MG	6.0 MG	2.5 MG
D3	375	1.91	3.15	0.5 MG	1.92 MG	3.2 MG	5.5 MG	8.5 MG	3.0 MG
La Costa Lo	318	3.00	4.95	0.7 MG	0.96 MG	5.0 MG	6.7 MG	1.5 MG	-5.2 MG
Ellery	330	1.15	1.90	0.3 MG	0.96 MG	1.9 MG	3.1 MG	5.0 MG	1.9 MG
Elm Skyline "E" Res.	255	3.70	6.11	0.9 MG	0.96 MG	6.1 MG	8.0 MG	4.5 MG	-3.5 MG
TOTALS		**16.2**	**26.8**	**4.0 MG**	**8.6 MG**	**26.8 MG**	**39.5 MG**	**50.5 MG**	**12.5 MG**

(1) Equal to the volume of water based on the largest fire flow within the tank service area (flow rate times duration). For large service areas, the fire flow storage was increased based on the potential for multiple fires.
(2) The 580 Zone has no available storage but can be supplied from the TAP Res. through the Calavera Pump Station.

The 1.5 MG La Costa Lo Reservoir establishes the grade for the 318 Zone and is the only reservoir in that zone. A daily storage capacity of 6.7 MG is required based on existing 318 Zone demands. The current storage deficit is calculated to be 5.2 MG, and site limitations prevent a larger reservoir from being constructed on the existing tank site. However, the 318 Zone has multiple supply sources from higher zones with storage reservoirs. Water can be supplied to the 318 Zone from 1) the D3 Reservoir through three separate PRVs, 2) the La Costa Hi Reservoir via the 680 and 510 Zones through two separate PRVs, and 3) the Santa Fe II Reservoir via the 550 Zone and the Ayes PRV (which is controlled by telemetry). There is currently more than eight million gallons of combined surplus storage capacity in these three upper reservoirs.

Three separate 1.5 MG reservoirs are located within the 255 Zone, with a combined storage capacity of 4.5 MG. There is currently a 3.5 MG storage deficit based on existing 255 Zone demands. The primary supply to the 255 Zone is from the 490 Zone and the Maerkle Reservoir. The surplus storage capacity in Maerkle Reservoir is estimated to be 8.5 MG, and this excess capacity can be allocated to the 255 Zone.

5.5.2 Emergency Storage

The CMWD emergency storage policy is to provide 10 days of average water use. Based on the existing ADD of 16.2 MGD, the required storaege volume is 162 MG. Maerkel Dam, which has a storage capacity of 195 MG, currently provides the required storage volume for the District.

CHAPTER 6
ULTIMATE DEMAND PROJECTIONS AND ANALYSIS

For this Master Plan Update, ultimate demand projections are made based on the City's 2001 Growth Database. The Growth Database includes build-out projections for ultimate single-family dwellings, multi-family units and commercial building square footage on a parcel-by-parcel basis. The CMWD ultimate water demand is projected based on existing demands, future water demands calculated from the Growth Database, and future irrigation demands obtained from recycled water projections. Future demands are added to the existing system hydraulic model along with major water facilities identified in existing development plans and previously identified future pipeline projects. A hydraulic analysis is performed with projected ultimate maximum day demands to verify and size the future facilities, and to identify any additional facilities required to serve the CMWD at buildout.

6.1 CARLSBAD GROWTH DATABASE

Build-out projections for the City of Carlsbad have been recently updated and compiled into a Growth Database, which is maintained by the City. The City of Carlsbad Growth Database is parcel-based and includes information on existing land use, as well as the future growth potential. The growth data, which is based on current development plans and results of the 2000 Census, consists of the number of projected single-family units, multi-family units, and the estimated building area for non-residential land use at build-out. The building area in the database is generally assumed at 25 percent of the parcel size, unless more detailed planning information was available. The existing percent build-out for each parcel is also provided in the Growth Database.

Most of the projected growth in the CMWD is associated with known, planned developments in the eastern portion of the City. These developments include Kelley Ranch, Villages of La Costa, Calavera Hills, Mandana Properties, and Robertson Ranch, which are primarily residential developments, the Carlsbad Oaks North and Faraday Business Parks, and Bressi Ranch, which will have a mixed-land use. Development information for these large planned projects is typically lumped onto a single existing parcel in the Growth Database, even if the project boundary encompasses several existing parcels or pressure zones. The remainder of the future growth in the City of Carlsbad includes smaller, non-specific developments and general "infill" of established neighborhoods and commercial areas generally located in the western portions of the City.

The Growth Database was originally provided by the City of Carlsbad at the start of this Master Plan Update project. During the course of the project, several updates to the projected future growth were provided by the City and incorporated into a modified database. The growth potential data in the City of

Carlsbad Growth Database used for this Master Plan Update is summarized by Local Facility Management Zone (LFMZ) in Table 6-1. The LFMZs are illustrated on Figure 6-1. Not all of the parcels included in the Growth Database are within the CMWD service area. Portions of LFMZ 6 are served by the Olivenhain Municipal Water District (OMWD) and all of LFMZs 11, 12 and 23 are served by either the OMWD or the Vallecitos Water District. The growth update indicates a slightly lower number of residential units and more commercial/industrial area than what was projected in the last Master Plan Update.

Table 6-1
CITY OF CARLSBAD GROWTH DATABASE SUMMARY

LFMZ No.	No. of Res. Units SFDU	MFDU	Non-Residential Bldg Area (sqft)	Comments
1	430	0	0	Downtown area; Unit counts from 5/15/02 LFMZ 1 update
2	25	146	39,656	3 second dwelling units counted as MFU
3	13	0	193,251	
4	0	0	50,000	
5	0	0	4,137,974	Includes Faraday Business Park and airport
6	185	0	89,988	Future church assumed at 9,100 sqft (25% coverage)
7	345	436	32,670	Calavera unit counts from 7/15/02 update; Future elem.school
8	186	544	6,000	Kelly Ranch
9	41	0	428,100	
10	750	320	0	Villages of La Costa; Future elementary school
11	1,266	275	622,972	Villages of La Costa
12	55	0	20,000	Future church assumed at 20,000 sqft
13	0	18	1,482,142	24 room hotel expansion assumed at 1 hotel unit =.75 MFDU
14	711	411	229,166	Unit counts from Robertson Ranch update; Future High School
15	807	158	303,798	Sycamore Creek; 8 second dwelling units counted as MFDU
16	0	0	1,921,000	Carlsbad Oaks North BP; Building area from 8/01/02 update
17	523	100	2,511,000	Bressi Ranch; 40,000 sqft for private school & daycare/church
18	308	0	2,262,817	140 condos counted as SFDU
19	218	78	69,520	61 condos counted as SFU; 78 timeshares counted as MFDU
20	687	24	73,450	
21	185	210	0	
22	168	286	53,280	149 condos counted as SFU
23	0	264	507,000	includes assisted living project (non-res & MFDUs)
24	32	0	0	
25	130	0	0	
Totals	**7,065**	**3,270**	**15,033,784**	

Note: shaded rows indicate LFMZs with parcels outside of the CMWD

6.2 GROWTH DATABASE UNIT WATER DEMANDS

Unit demands based on current water usage are documented in Chapter 4 (Section 4.5) of this report. These unit demands should not be used directly for planning purposes, however, as more conservative demands are developed for the calculation of ultimate demands. The unit demands developed to project ultimate water demands from buildout data in the Growth Database are listed in Table 6-2. These water demands were reviewed and approved by CMWD Staff at one of the project review meetings.

Table 6-2
UNIT DEMANDS FOR ULTIMATE PROJECTIONS

GROWTH DATABASE LAND USE TYPE	PROJECTED WATER USE FACTOR	DEVELOPMENT UNIT
Single-Family Residential	550 gallons per day	per dwelling unit
Multi-Family Residential	250 gallons per day	per dwelling unit
Non-Residential	2,300 gallons per day	per 10,000 square feet of building area

Unit demands for single and multi-family land use are applied to the projected number of dwelling units, and account for both domestic and irrigation water use. The unit demand for non-residential land use is applied to the building area, and accounts for interior water use as well as on-site irrigation demands. The non-residential land-use category in the Growth Database includes commercial, industrial, medical and office buildings. The composite unit demand is based on an assumed mix of land use types and is appropriate (and most likely conservative) for demand projections of the overall water system. Projections made using this factor may not be representative of smaller areas with a single land use type.

6.3 ULTIMATE DEMAND PROJECTIONS

Ultimate demand projections are based on build-out conditions for the CMWD, which is projected to occur by the year 2020. The CMWD is surrounded by four neighboring districts, and there is no expectation of altering the current district boundary in the future. Ultimate demand projections are therefore made based on the existing CMWD boundary.

The scope of work for this Master Plan Update states that "ultimate demand projections are to be based on the assumption that the planned Phase II expansion of the CMWD Recycled Water System is not constructed". To estimate ultimate demands, demand projections for future development identified in the Growth Database and irrigation demands identified from the 1999 Recycled Water Master Plan are added to existing system demands. The ultimate potable water demands therefore exclude recycled water demands currently served by the CMWD Phase I Recycled Water System, but include the future irrigation demands identified in the CMWD Recycled Water Master Plan for the Phase II System.

The ultimate demand for CMWD potable water system is projected to be approximately 23.9 MGD, and the maximum day demand is estimated at 35.9 MGD (based on a peaking factor of 1.65). The projected ultimate demand under various peaking conditions is listed in Table 6-3.

Table 6-3
SUMMARY OF PROJECTED ULTIMATE DEMANDS

Average Day	23.9 MGD	37.0 CFS
Minimum Month	12.0 MGD	18.5 CFS
Maximum Month	35.9 MGD	55.5 CFS
Maximum Day	39.4 MGD	61.0 CFS
Peak Hour	69.3 MGD	107.2 CFS

The projected ultimate demand is illustrated together with historical demands on Figure 6-2. An approximation of the ultimate water use by category is provided in Figure 6-3. Compared to the existing water use, the percentage of industrial/commercial and irrigation demands is projected to increase slightly, and the percentage of residential demands is projected to decrease slightly. Water use for agriculture is projected to decrease from five percent of the existing demand to approximately one percent of the ultimate demand. If the Phase II Recycled water system is constructed, ultimate irrigation demands will decrease as existing customers are transferred from the potable water system to the recycled water system, and future irrigation customers are connected directly to the recycled water distribution system. The ultimate demand without Phase II Recycled water customers is projected to be approximately 21.2 MGD. It is noted that not all the Phase II Recycled Water demands, which have been identified by City Staff, are within the CMWD potable water service area.

The process of generating ultimate demands utilizes the City of Carlsbad Growth Database. However, the Growth Database does not contain information on future irrigation demands or future development on City-owned parcels, which include future schools and park sites. These future demands are accounted for separately. The process used to develop the ultimate demand projections is described in the following sub-sections.

Figure 6-2
HISTORICAL DEMANDS AND ULTIMATE DEMAND PROJECTIONS

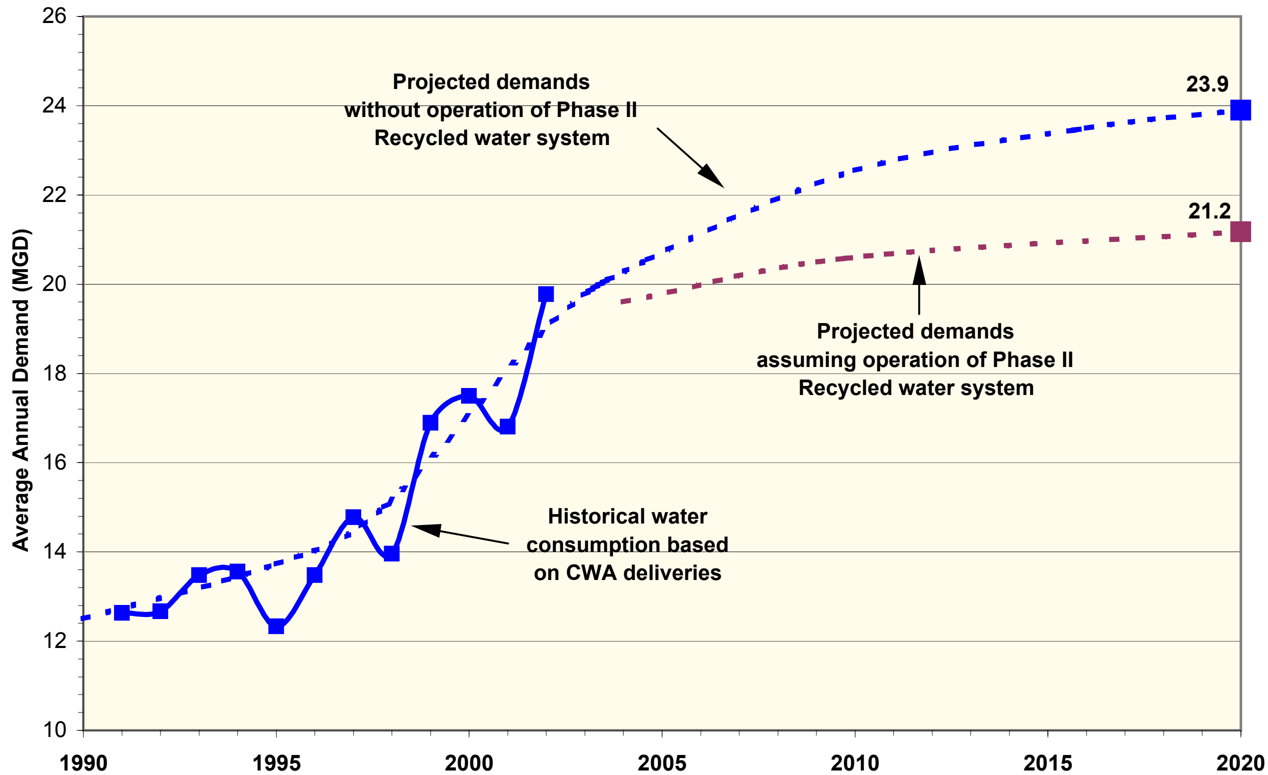
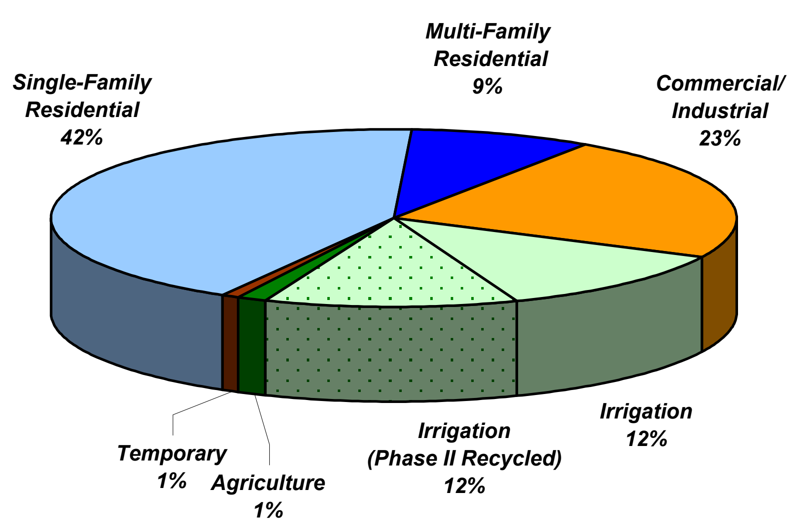


Figure 6-3
PROJECTED ULTIMATE DEMANDS BY CATEGORY



6.3.1 Growth Database Demands

To determine ultimate demands from the Growth Database, future demands were calculated for each parcel using the unit factors in Table 6-2 and added to the water demand data from 2001 water billing accounts. For parcels in the Growth Database that indicate both existing and future development (a build-out percentage between zero and 100 percent), the future demand was added to the existing demand. For parcels with only future development, the future demand replaced any existing demand on that parcel. The existing demand that was replaced was typically from single-family or agriculture meters. The future water demand based on Growth Database projections for parcels within the CMWD is approximately 6.9 MGD.

6.3.2 Irrigation Demands

Water demands projected from the Growth Database include on-site irrigation demands for residential and non-residential parcels. However, future landscape irrigation for such uses as the irrigation of parks, playgrounds, golf courses, landscaped areas along freeways, green belts, and extensive common-area landscaping for industrial and commercial parks and subdivisions is not included. Demand projections for this type of water use are obtained from the City's compilation of identified future Phase II Recycled water customers. The planned Phase II Recycled Water System will serve all the major new development areas within the CMWD potable water service area.

A Recycled Water Master Plan was last prepared for the CMWD by a consultant in 1999. Since this last master plan, the City of Carlsbad has updated recycled water projections for the future Phase II Recycled Water System based on updated development plans. The most recent projections, dated September 28, 2001, were obtained from the City and used for this Master Plan Update. The water demands identified as being supplied by the Phase II Recycled Water System include both existing water demands now served from the potable water system and future demands. City Staff indicated which demands were future demands. The future Phase II recycled irrigation demands that are within the CMWD potable water service area are listed in Table 6-4.

The projected demand in Table 6-4 was calculated by the City based on unit demand factors that varied between 2.0 and 3.75 acre-feet of water per acre per year. The exception is the projected demands for future business parks. Only half of the projected irrigation demand for future business parks (Customer No.'s C-13, C-13 and C-19) was added to the ultimate potable water system, since the unit demand factor for non-residential development in the Growth Database includes an on-site irrigation component. The total <u>future</u> irrigation demand in the ultimate potable water system based on Phase II recycled water projections is approximately 1.8 MGD. It is noted that existing irrigation demands of approximately 0.9 MGD that are now supplied from the potable water system have also been identified as being supplied from the future Phase II Recycled Water System.

Table 6-4
FUTURE PHASE II RECYCLED WATER DEMANDS
IN THE POTABLE WATER SERVICE AREA

Cust. No.	Market Name	Recyled Water Model		Potable Water Model		Projected Demand	
		Node No.	Zone	Node No.	Zone	(af/yr)	(gpm)
	FUTURE MARKETS						
G-01	Carlsbad Municipal Golf	2012	384	5346	375	384.0	238.1
P-08	Marcario Canyon Park	1148	384	5348	375	250.0	155.0
R-68	Kelly Ranch	1152	384	5352	375	54.0	33.5
P-25	Zone 19 Park	1028	550	5354	550	30.0	18.6
R-47	Villages of La Costa (Greens)	1218	384	5356	375	372.5	231.0
P-24	Zone 5 Park	2028	550	5358	550	25.0	15.5
R-22	Robertson Ranch	1288	550	5362	255	190.0	117.8
R-78	Bressi Ranch	1224	384	5372	550	125.0	77.5
R-78	Bressi Ranch	3000	660	5374	700N	275.0	170.5
S-15A	Calavera Lake School	5012	550	5452	446	37.5	23.3
R-14	Calavera Villages	5008	550	5454	446	178.0	110.4
C-12	Carlsbad Oaks Business Ctr.	3004	660	5366	700N	114.0	70.7
C-13	Raceway Industrial Park	3014	660	5368	700N	13.2	8.2
C-19	Industrial (Professor's Capitol)	3014	660	5368	700N	12.5	7.8
FUTURE MARKET SUBTOTALS:				**1.84 MGD**		**2,061 af/yr**	**1,278 gpm**

6.3.3 Miscellaneous Demands

The City's Growth Database does not provide future growth information for City-owned parcels. Future development on City parcels will include schools, parks and a municipal golf course. Irrigation demands for future City parks and the golf course are identified in Table 6-4 above. City Staff have identified three future elementary schools and a future high school. Water demands for these schools were developed separately and included in the ultimate potable water demand projections.

Existing agriculture demands were reviewed to determine if they would remain in the ultimate water system. Most existing areas devoted to agriculture will be replaced with future planned developments. Because the buildout projections for large development projects in the Growth Database are typically lumped onto a single parcel, the existing demand from agriculture meters was not always replaced by new development. Existing agriculture meters with large demands were reviewed and removed from the ultimate system as necessary. Based on discussions with City Staff, agricultural areas will remain at buildout conditions on the south side of the Agua Hedionda Lagoon (the "strawberry fields") and at the flower fields north of Palomar Airport Road, between Armada Drive and Paseo del Norte. In addition, demand from agricultural meters distributed throughout the City remains in the ultimate system if there was no future growth designated for the associated parcel in the Growth Database. The average annual demand from agricultural meters in the ultimate system is estimated to be approximately 0.34 MGD.

It is noted that in the existing distribution system, supplemental potable water is supplied to the Phase I Recycled Water System at the location of the D tanks. The average annual demand supplied in 2001 was 250 gpm (0.36 MGD). This demand remains in the ultimate system model on the assumption that supplemental potable water will continue to be supplied to the Phase I Recycled Water System. If the Phase II Recycled Water System is constructed, City staff have indicated that varying amounts of supplemental water may still be required during peak demand periods.

6.4 HYDRAULIC MODEL DEVELOPMENT

Future demands in the ultimate system will be supplied from an expansion of the existing distribution system pressure zones. It is anticipated that no new major pressure zones will be required, although water service to the high elevation area west of Maerkle Dam will require pumping. The initial ultimate system $H_2ONET^{®}$ model was developed from the existing system model, layout plans for planned developments, and current CMWD CIP projects. The hydraulic profile of the ultimate system as modeled is provided in Figure 6-4 and the final ultimate system model is illustrated on Figure 6-5.

6.4.1 Physical Data Input

Future transmission facilities were added to the existing system model based on layout plans for planned developments and the existing CMWD CIP. Layout maps in various stages of development were provided by City Staff for most of the larger planned developments. These maps were used to determine future pressure zone boundaries and water supply locations. The alignments of transmission mains and the locations of future pressure reducing stations within specific projects were added to the model based on the planning maps. It is noted that future distribution pipelines are included in the ultimate model to distribute demands. The final sizing of distribution pipelines within planned developments will be determined from future hydraulic analyses required as part of the development approval process.

Once facilities in the future developments were added, the City's current CIP was reviewed with City Staff. Facilities currently in design or under construction were added to the model. The remaining CIP projects were reviewed and modified as appropriate based on updated planning information, and then added to the model for analysis and verification. Major proposed facilities for the ultimate system include the integration of the 700N and 700S Zones into a single 700 Zone with new north-south transmission mains and a second transmission main supplying the 490 Zone from Maerkle Reservoir/Dam.

Eight future pressure reducing stations were input to the ultimate system model based on development plans and existing CIP projects. Four of these pressure reducing stations are required to provide a redundant source of water, and are therefore considered to be back-up or emergency facilities. The other four stations were modeled with pressure settings so that they are normally active in the system. These stations will supply the 446 Zone and the 255 Zone from the 490 Zone, and the 550 Zone and the 375

Zone from the 700 Zone. It is noted that the ultimate system model includes only the existing storage facilities. However, additional storage facilities are recommended to satisfy the required storage criteria (discussed later in this chapter). A new pump station was added to the model to supply the 700 Zone from the 490/550 Zone. This pump station is only active in the model under the emergency supply scenario from Maerkle Dam.

6.4.2 Demand Input

Projected demands were input to the ultimate system model using a multi-step process. The resulting ultimate demands by pressure zone are calculated within the H_2ONET® hydraulic program and are shown in Table 6-5.

Table 6-5
EXISTING AND ULTIMATE DEMANDS BY PRESSURE ZONE

PRESSURE ZONE	EXISTING 2001 DEMAND (MGD)		PROJECTED ULTIMATE DEMAND (MGD)	
	Average Annual	Max Day (x 1.65)	Average Annual	Max Day (x1.65)
198	0.08	0.14	0.08	0.14
255	3.67	6.05	4.07	6.71
285	0.16	0.26	0.14	0.23
318	2.94	4.84	3.60	5.94
330	1.11	1.84	1.10	1.82
349	0.09	0.15	0.09	0.15
375	1.93	3.18	4.02	6.63
430	0.13	0.21	0.21	0.35
446	1.56	2.57	2.25	3.71
490	0.03	0.06	0.36	0.59
510	0.20	0.33	0.31	0.51
550	2.69	4.44	3.86	6.37
580N	0.42	0.69	0.51	0.84
580S	0.06	0.10	0.06	0.10
680	0.42	0.69	0.42	0.69
700	0.78	1.29	2.80	4.62
TOTALS:	**16.3 MGD**	**26.8 MGD**	**23.9 MGD**	**39.4 MGD**

As a first step in distributing demands to the ultimate system model, existing meter accounts and future demands determined from the Growth Database were located to the City's parcel GIS layer. The resulting demand set was allocated to model nodes utilizing GIS techniques to group parcel demands to the nearest node. For areas of the model where a transmission main for one zone extends through the service area of a different zone, the nodes on the transmission main were "tagged" to prevent demands from being assigned. The future development associated with several of the larger planned development projects was assigned to a single parcel in the Growth Database. The associated demands for these development projects, which include Bressi Ranch, Villages of La Costa, Calavera Hills, Mandana Properties and Robertson Ranch, were manually distributed over multiple nodes on future pipelines input to the model based on the development layouts.

Future Phase II recycled water demands were manually input to the ultimate system model based on their locations in the recycled water model and input from City Staff. The future irrigation demands were assigned to new nodes and identified as being potential Phase II recycled water demands. Existing irrigation demands now served from the potable water system that are identified as future Phase II Recycled Water System were also located in the model. These demands were obtained from the City's Phase II recycled water projections, and are shown in Table 6-6. Existing irrigation meter accounts corresponding to the location of these customers were transferred to the set of potential Phase II recycled water demands in the ultimate system hydraulic model. A total average annual demand of 2.73 MGD was identified in the CMWD ultimate system model as potentially being served from the Phase II Recycled Water System.

Table 6-6

EXISTING IRRIGATION DEMANDS IDENTIFIED AS PHASE II RECYCLED CUSTOMERS

Cust. No.	Market Name	Recyled Water Model		Potable Water Model		Estimated Demand	
		Node No.	Zone	Node No.	Zone	(af/yr)	(gpm)
C-06	Poinsettia Village Shopping Ctr.	4030	384	5320	318	12.8	7.9
R-77	Poinsettia Shores PA 7&8	4032	384	5146	318	37.5	23.3
R-39	Seacrest	1215	384	5200	375	7.0	4.3
R-46	Lohf Residential	1006	384	5116	375	85.0	52.7
C-11	Industrial Center (Fed Ex)	2040	550	3430, P254, 3480	550	103.1	63.9
G-07	Olympic Resort and Hotel	2042	550	1742	550	14.3	8.9
L-22	Safety Center	2163	550	3425	550	6.0	3.7
R-13	Calavera Cape	5028	550	5136	446	22.5	14.0
R-46	Lohf Residential	2056	550	6530	318	180.0	111.6
P-06	Calaveras Park	5028	550	440	580	47.3	29.3
P-14	Carrillo Ranch Park	3026	660	P518	700	37.0	22.9
R-48	Carrillo Ranch Park	3016	660	5012	700	105.0	65.1
R-49	Carrillo Ranch	3022	660	P504	700	57.5	35.7
R-50	Meadowcrest	2098	660	1686	550	8.3	5.1
R-51	Meadowlands	3020	660	5018	550	14.0	8.7
R-40	Vista Pacific	1248	384	5150		24.0	14.9
C-08	Carlsbad Research Center	2024	550	5178, 1698 1704, 3695, 3540 3904, 4100, 3450	430 550 550 550	202.2	125.4
C-09	Carlsbad Airport Center	2102	375	4512 4555, 4570	375 550	34.9	21.6
	EXISTING MARKET SUBTOTALS:					**998 af/yr** **0.89 MGD**	**619 gpm**

6.5 ULTIMATE SYSTEM HYDRAULIC ANALYSIS

Hydraulic analysis of the ultimate system was performed to size and verify proposed future facilities. The ultimate system model was analyzed under both maximum day demand and emergency supply scenarios. Several iterations of the ultimate system model were developed as proposed facilities were added or modified based on analysis results. The final ultimate system model and simulation results are provided in digital format and included in Appendix B.

6.5.1 Maximum Day Demand 24-Hour Simulation

Projected demands corresponding to an ultimate system maximum demand day were developed and input to the ultimate system model to identify and size future facilities. The 24-hour maximum day peaking curve developed for the existing system analysis (refer to Figure 5-1) was applied to all demands in the ultimate system model with the exception of irrigation demands designated as future Phase II recycled demands. To more accurately model Phase II recycled demands, the peaking curve developed for irrigation demands in the CMWD Recycled Water Master Plan was applied. The recycled water peaking curve is based on a maximum day peaking factor of 2.5 and an evening irrigation period starting at approximately 9:00 p.m. and peaking at midnight. The resulting total maximum day demand modeled is 40.9 MGD, which is therefore slightly higher than the projected maximum day demand of 39.4 using an overall peaking factor of 1.65.

Reservoir water levels were initially set at half full in the simulation. Input flow to the ultimate distribution system model was set equal to the maximum day demand rate (40.9 MGD) and proportioned between the four SDCWA connections. Input flows were adjusted between the four connections, as necessary, to maintain reservoir water levels. Supply from SDCWA Connection No. 3 (Supply to Maerkle Reservoir/Dam) was maximized based on the increased transmission capacity of the 490 Zone and the benefit of increased circulation in Maerkle Dam.

Extended period simulations were run to determine final pipeline sizing and assess reservoir performance (the ability to supply peak flows and refill after draining). Several simulation iterations were required to properly adjust the SDCWA inflows, distribution system valves with variable settings, and pressure settings for new pressure reducing valves. Flow from the 550 Zone to the 375 Zone at the D3 Reservoir (through the throttled plug valve) was set at 2,000 gpm and there was no flow through the Maerkle Control Valve (supply to the 490 Zone from the 550 Zone). Pump stations were not activated in this simulation. The final SDCWA inflows modeled at the aqueduct connections are shown in Table 6-7. It is noted that the supply from SDCWA Connection No. 2 is at the existing rated capacity, and the supply from the Maerkle Connection is nearly at capacity.

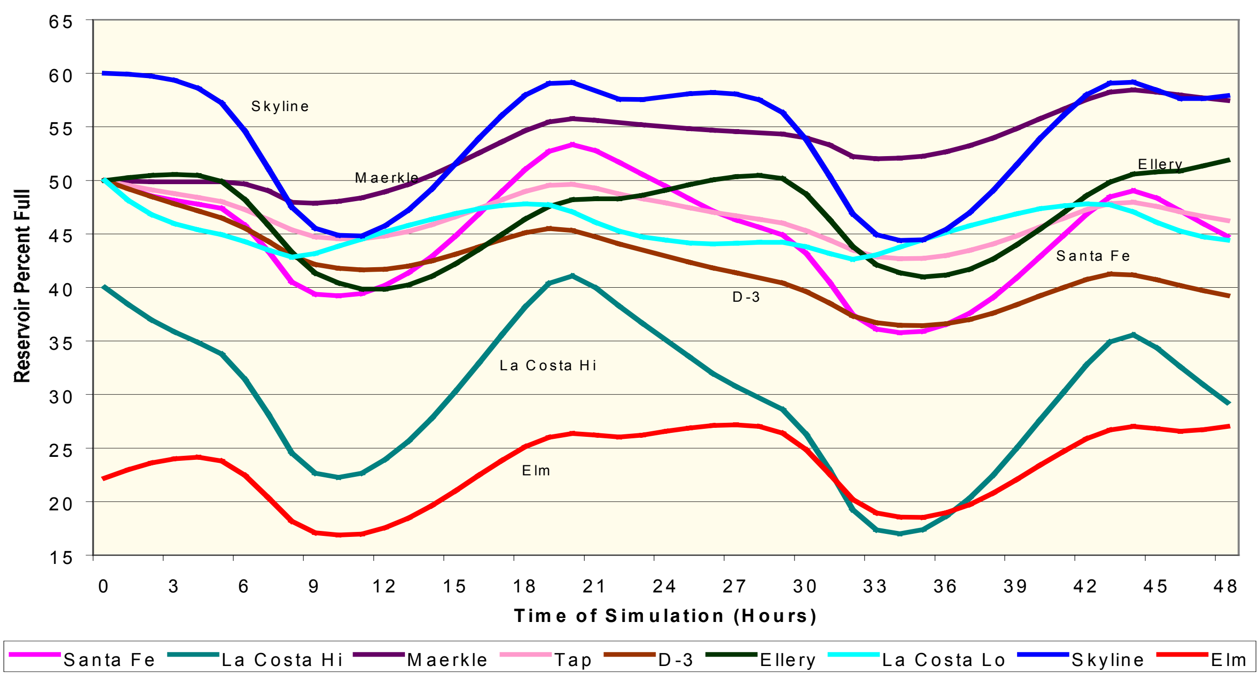
Table 6-7
SDCWA MAX DAY SUPPLY IN THE ULTIMATE SYSTEM MODEL

San Diego County Water Authority Connection	Rated Capacity*		Supply in Ultimate System Model with Max Day Demands	
	(MGD)	(cfs)	(MGD)	(cfs)
CWA No. 1 (Palomar Airport Road Connection)	23.3	36.0	16.2	25.0
CWA No. 2	8.6	13.3	8.6	13.3
TAP No. 3 (Maerkle Connection)	11.6	18.0	11.0	17.1
TAP No. 4 (TAP Connection)	8.7	13.5	5.1	7.8
TOTALS	**52.2**	**80.8**	**40.9**	**63.3**

* Rated capacity for Conn. No. 1, 3 and 4 is the capacity of the SDCWA meter at the turnout, minus 10%.
Rated capacity for Conn. No. 2 is based on a contractual agreement with VWD, OMWD, and Carlsbad.

Model results from the maximum day demand simulation were reviewed to assess system operations and reservoir performance. Reservoir operations are evaluated based on the ability of the tanks to drain to supply peak hour demands and refill overnight. Figure 6-6 illustrates the resulting reservoir levels during the maximum day simulation, which was extended over 48-hours to fully equalize reservoir flows.

Figure 6-6
RESERVOIR WATER LEVELS FROM THE MAXIMUM DAY DEMAND SIMULATION



As is shown on the Figure 6-6 chart, the existing reservoirs in the ultimate system are able to supply operational storage and refill. For the zones with multiple reservoirs (255 Zone and 700 Zone), the starting levels of the reservoirs were adjusted to "balance" the zone, ensuring that one reservoir did not drain to fill the other. In the 255 Zone, the operating difference in the Elm and Skyline Reservoir levels is due to the different bottom and high water levels of these tanks. It is noted that the Skyline Reservoir is typically operated with a higher water level in the existing distribution system.

6.5.2 EMERGENCY SUPPLY SCENARIO

The ultimate system model was analyzed under an emergency supply scenario, with average day demands supplied from the Maerkle Dam. In this simulation, the 24-hour peaking curve was revised based on average day demands and flow inputs at the SDCWA Connections were set to zero. The bypass at the Maerkle Control Valve was opened, and the five pressure reducing stations supplying the 550 Zone from the 700 Zone were closed. This creates an integrated 490-550 zone, which operates at a grade controlled by the Maerkle Reservoir. The Calavera Hills Pump Station was operated to supply the 580 Zone. Lastly, a pump station was added to the model at the intersection of El Camino Real and Palomar Airport Road to supply the 700 Zone from the 490-550 Zone. The capacity of the pump station was set equal to the average day demand of the 700, 680 580S and 510 Zones, which is approximately 3.6 MGD or 2,500 gpm.

A 24-hour simulation was run, and model results indicated that average day demands could be supplied to the entire distribution system from Maerkle Reservoir. However, the capacity of the Maerkle Reservoir Pump Station, which supplies Maerkle Reservoir from Maerkle Dam, will have to be increased to approximately 16,500 gpm (23.9 MGD), which is the projected average day demand. Although pressures in the 550 Zone dropped by approximately 25 psi, analysis results indicate that the required 40 psi minimum pressure could be maintained. It is noted that limiting the flow rate through the proposed 700 Zone pump station to 2,500 gpm is necessary to maintain adequate pressures in the 550 Zone (a higher flow to the station will reduce downstream pressures in the 490-550 Zone from higher pipeline friction losses). Under the emergency supply simulation with average day demands, water levels in the 700 Zone Reservoirs gradually drained, since these reservoirs also supply a portion of the 318 Zone through the 510 Zone. Under extended emergency conditions, settings at pressure reducing stations supplying the 318 Zone could be adjusted to increase supply from the 375 Zone and reduce supply from the 700 Zone.

6.6 STORAGE ANALYSIS

The required storage volume based the criteria previously defined in Table 5-1 and projected ultimate demands is calculated and compared to the capacity of the existing system reservoirs, as discussed below.

6.6.1 Daily Storage

Daily storage is provided in distribution system reservoirs. To determine the required storage volume, reservoir service areas and corresponding demands were determined based on the proposed ultimate distribution system. Calculations to determine the required storage volume are shown in Table 6-8. Based on these calculations, there is projected to be a storage deficit of approximately 4.5 million gallons (MG) in the ultimate system. Additionally, the District is considering the removal of the 1.5 MG "E" Reservoir from the system, which does not operate together with the other two 255 Zone reservoirs due to its elevation. Maerkle and Ellery Reservoirs are projected to have a combined surplus storage capacity of 9.9 MG, but the remaining reservoirs show capacity deficits.

Table 6-8
ULTIMATE DAILY STORAGE REQUIREMENTS

RESERVOIR	Service Zones	Projected Demand		Storage Requirements				Reservoir Capacity	Available Emergency Capacity
		ADD (MGD)	MDD (MGD)	Operational (.15 x MDD)	Fire Flow(1)	Reserve (1 MDD)	Total		
Santa Fe II & La Costa High	700 680 580S 510 550 430	2.80 0.42 0.06 0.31 3.86 0.21	4.61 0.70 0.10 0.52 6.38 0.35	1.9 MG	2.88 MG	12.7 MG	17.4 MG	15.0 MG	-2.4 MG
Maerkle Res.	490 285 198	0.36 0.14 0.08	0.60 0.24 0.13	0.1 MG	0.96 MG	1.0 MG	2.1 MG	10.0 MG	7.9 MG
TAP	580(2) 446 349	0.51 2.25 0.09	0.85 3.71 0.15	0.7 MG	0.96 MG	4.7 MG	6.4 MG	6.0 MG	-0.4 MG
D3	375	4.02	6.64	1.0 MG	1.92 MG	6.6 MG	9.6 MG	8.5 MG	-1.1 MG
La Costa Lo	318	3.60	5.94	0.9 MG	0.96 MG	5.9 MG	7.8 MG	1.5 MG	-6.3 MG
Ellery	330	1.10	1.82	0.3 MG	0.96 MG	1.8 MG	3.0 MG	5.0 MG	2.0 MG
Elm Skyline "E" Res.	255	4.07	6.72	1.0 MG	0.96 MG	6.7 MG	8.7 MG	4.5 MG	-4.2 MG
TOTALS		**23.9**	**39.4**	**5.9 MG**	**9.6 MG**	**39.4 MG**	**55.0 MG**	**50.5 MG**	**-4.5 MG**

(1) Equal to the volume of water based on the largest fire flow within the tank service area (flow rate times duration). For large service areas, the fire flow storage was increased based on the potential for multiple fires.
(2) The 580 Zone has no available storage but can be supplied from the TAP Res. through the Calavera Pump Station.

6.6.2 Emergency Storage

The CMWD emergency storage policy is to provide 10 days of average water use. Based on the projected ultimate average annual demand of 23.9 MGD, the required storage volume is 239 MG. If demands identified as being supplied from the future Phase II Recycled Water System are not included, the projected ultimate demand is approximately 21.2 MGD, and 212 MG of emergency storage will be required. Maerkle Dam is reported to have a storage capacity of 195 MG. Therefore, additional storage will need to be constructed to comply with the CMWD emergency storage policy.

6.7 ULTIMATE SYSTEM OPERATIONS

The proposed ultimate distribution system based on the results of the hydraulic analysis is illustrated on Exhibit 2 in Appendix A. The major changes to the existing system and revised system operations, as modeled, are discussed below for the major pressure zones:

700 Zone – In the ultimate system, the existing 700N and 700S Zones will be integrated into a single zone with two reservoirs. Ultimate demands in the 700 Zone are projected to increase by over 300 percent from 2001 demands. Future development projects that will be supplied primarily from the 700 Zone include the Carlsbad North Business Park and the Raceway Industrial Park. Portions of Bressi Ranch will also be supplied directly from the 700 Zone. New 700 Zone mains are planned in the future alignments of El Fuerte Street and Melrose Drive.

The La Costa Hi and Santa Fe II Reservoirs will operate together in the ultimate 700 Zone. These reservoirs have a common bottom elevation of 700 feet, but the overflow elevation of the Santa Fe II Reservoir is approximately five feet higher than the overflow on the La Costa Hi Reservoir. In the ultimate simulation with projected maximum day demands, these two reservoirs operate at slightly different high water levels. The water level of the La Costa Hi Reservoir remains approximately six feet lower than the level of the Santa Fe II Reservoir. This is due to the long transmission main between the Santa Fe II Reservoir and the 700 Zone distribution system, and the supply limitation at the SDCWA No. 2 Connection. During lower demand periods when less flow is ordered from the SDCWA No. 1 Connection, the high water level of these reservoirs will be closer together.

A new pump station at the northeast corner of El Camino Real and Palomar Airport Road will supply the 700 Zone under emergency conditions from the Maerkle Dam and the 550 Zone.

580N Zone - The 580N Zone serves residential demands in the northern part of the CMWD service area and is supplied directly from the SDCWA TAP No. 4 Connection. The grade in this zone is established by the TAP pressure sustaining valve, which discharges excess supply to the TAP Reservoir. Demands are projected to increase to approximately 0.51 MGD, which is a 20 percent increase over existing demands. The 580N Zone distribution system will expand to serve future development within Calavera Hills.

There is no storage in the 580 Zone. In the event of a fire, all flow supplied from the TAP No. 4 Connection would be available to the 580N Zone, as a pressure drop in system would close the TAP sustaining valve. To provide a 1,500 gpm residential fire flow with maximum day demands from the TAP No. 4 Connection, a minimum flow of approximately 3 MGD or 4.7 cfs would need to be ordered. In the ultimate MDD hydraulic simulation, 7.8 cfs was supplied in the model.

The Calavera Hills Pump Station, which supplies the 580N Zone from the TAP Reservoir, can provide an additional 1,500 gpm for fire flows or an emergency supply. The capacity of this pump station is sufficient to supply projected ultimate peak hour demands for the 580N Zone. However, the existing pump station does not have sufficient capacity to supply a 1,500 gpm residential fire flow in addition to average day demands. An additional pump, back-up generator and hydropnuematic tank are proposed for this facility.

550 Zone - Existing and future supply to the 550 Zone is from the 700 Zone. Demands in the 550 Zone are projected to increase by approximately 40 percent. The existing 550 Zone will be expanded to serve portions of the planned Carlsbad North Business Park and most of the planned development within Bressi Ranch. A new 550 Zone pipeline will be constructed in the future alignment of El Fuerte Street to supply Bressi Ranch from the existing Melrose PRS. Construction of this pipeline will connect the isolated portion of the 550 Zone (existing 550E Zone) with the remainder of the 550 Zone. A future PRS near the east end of the CMWD boundary along the future extension of Faraday Avenue will increase supply to the 550 Zone.

During shutdowns of the SDCWA aqueduct or in emergency supply conditions, the 550 Zone will continue to be supplied directly from the Maerkle Reservoir at a reduced hydraulic grade through the Maerkle Control Vault.

510 Zone - The existing 510 Zone is very small, and serves residential development in the La Costa area. In the ultimate system, the service area of this zone will expand to the north and supply portions of the Villages of La Costa, increasing the 510 Zone demand by approximately 50 percent. A new PRS for emergency/fire flow conditions is planned within the Villages of La Costa to provide an additional source of supply from the 680 Zone.

490 Zone – The existing 490 Zone, which is supplied from Maerkle Reservoir, serves very little demand directly but is the main supply to the 330, 285 and 255 Zones. The 490 Zone also supplies the 446 and 375 Zones. In the ultimate system, the 490 Zone service area will expand to include future development within Mandana Properties, Cantarini, and Kelley Ranch. Ultimate demands within the 490 Zone service area are projected to increase tenfold, but will still be less than existing demands in the 680 Zone.

Transmission main improvements are proposed for the 490 Zone to increase capacity under normal and emergency operations and provide a redundant supply from Maerkle Dam. A 36-inch diameter transmission main is proposed to parallel the existing 27-inch diameter supply main from Maerkle Reservoir, and a new main will be constructed in the future alignment of College Boulevard. The 490 Zone main in College Boulevard will supply the future development of Robertson Ranch through a new PRS to the 255 Zone, and the future Calavera Hills development through a new PRS to the 446 Zone. Supply to the 375 Zone will also increase from an upgrade of the existing Grosse PRS.

Pressure settings for the new PRVs were set to maximize supply from the 490 Zone and the SDCWA TAP No. 3 Connection in the ultimate system model. This operational adjustment was done to take advantage of the additional pipeline capacity, excess daily storage capacity in Maerkle Reservoir, and to increase water circulation in Maerkle Dam. In the event of a loss of water supply from the SDCWA, the 490 Zone with proposed system improvements will be able to supply the entire CMWD service area from Maerkle Dam (refer to Section 6.5.2).

446 Zone – Ultimate demands in the 446 Zone are projected to increase by over 40 percent. The existing 446 Zone distribution system will expand to serve future development in Calavera Hills and a portion of Robertson Ranch. A new 446 PRS is planned at the terminus of the 490 Zone main in the future extension of College Boulevard. A new 446 Zone main will extend north in College Boulevard and connect with the existing portion of the 446 Zone distribution system in College Boulevard.

375 Zone - Ultimate demands in the 375 Zone are projected to be more than double the existing demands. The service area the 375 Zone will expand to supply portions of the Villages of La Costa, Cantarini, and Kelley Ranch. Several large future irrigation demands will also be served from this zone if the Phase II Recycled Water System is not constructed. These future irrigation demands include the Carlsbad Municipal Golf Course, Marcario Canyon Park, and Villages of La Costa (Greens).

In the existing distribution system, there are two small isolated areas of the 375 Zone. The first area, just north of El Camino Real and east of College Boulevard, is supplied from the 490 Zone through the Grosse PRS. The second area is a part of Kelley Ranch that is accessed from El Camino Real and Cannon Road and supplied from the Jackspar PRS. Future 375 Zone pipelines are included in the ultimate system to integrate these areas with the rest of the 375 Zone. Additionally, future pipelines in Cannon Road, College Boulevard, and through Mandana Properties will create a looped 375 Zone distribution system.

In the maximum demand day simulation, the pressure setting at the Grosse PRS (which will be enlarged) was adjusted so that the station would be active and supply the 375 Zone from the 490 Zone. It is noted that when this occurs, pressures in the formerly isolated area of Kelley Ranch will increase by approximately 25 psi (based on the existing setting of the Jackspar PRV, as provided by the Operations Staff). Analysis results from the ultimate maximum day demand simulation indicate that pressures in the existing portion of the Kelley Ranch development will be between 120 and 150 psi.

A new PRS is proposed to supply the future Villages of La Costa development in the 375 Zone from the 700 Zone. A new 375 Zone transmission main in Poinsettia Lane will connect this area of the 375 Zone with the D3 Reservoir.

318 Zone – Demand served from the ultimate 318 Zone is projected to increase by approximately 20 percent from existing 2001 demands. The 318 Zone service area will expand to serve a portion of the future Villages of La Costa development. A new PRS is planned to supply the 318 Zone form the 375 Zone within Villages of La Costa. This PRS is considered to be an emergency/fire flow supply and was not active in the hydraulic model.

255 Zone – Demands in the ultimate 255 Zone are projected to increase by approximately 10 percent over existing demands. The 255 Zone service area will expand to serve most of Robertson Ranch, future development in LFMZ 25, and a small area east of College Boulevard, which includes a future high school. Looped 255 Zone pipelines are planned within Robertson Ranch and east of College Boulevard. These pipeline loops will be connected with the existing 255 Zone distribution system via a proposed pipeline in El Camino Real.

A new PRS is proposed at College Boulevard and the access road to Robertson Ranch, which will supply the 255 Zone from the 490 Zone. A second PRS is proposed for development in LFMZ 25, which will supply the 255 Zone form the 446 Zone. In the ultimate system hydraulic model, pressure settings for the two future PRSs were adjusted to supply all of the future development. This was done to limit the flow increase through the existing May Company PRS (the primary supply to the 255 Zone) and the downstream 255 Zone pipelines, which are flowing with high velocities during peak demand periods.

The remaining pressure zones in the existing distribution system not listed above (198, 285, 330, 349, 430, and 680 Zones) are nearly built-out, and only minor demand and service area changes are projected for the ultimate system. With the exception of a new PRS to provide a redundant supply to the 680 Zone, no future transmission mains or supply facilities have been identified for these zones.

6.8 SEAWATER DESALINATION

A feasibility study has been prepared by a private company for a future 50 MG seawater desalination facility adjacent to the Encina Power Plant. The plant could eventually be expanded to a 100MG facility. The high quality drinking water would be sold based on long-term water sales agreements, and a draft water purchase agreement has been submitted to the SDCWA for their consideration. The proposed desalination plant would deliver desalinated water to CMWD, the City of Oceanside, VID, VWD, and the SDCWA. Desalinated water would be pumped from the desalination facility in a new 48-inch diameter pipeline to Maerkle Dam and Maerkle Reservoir prior to distribution to the various use areas. Maerkle Dam would therefore be converted to a desalinated water storage facility.

CMWD is currently conducting its own internal evaluation of the desalination study separate from the Water Master Plan Update. SDCWA staff is also reviewing the feasibility study and is in discussion with staff at Carlsbad and Oceanside over coordinating technical review of the proposal. CMWD has expressed concern over the mixing of desalinated water with imported water from the SDCWA, and the effect of changing supply sources on customers. Specifically, changes in taste, mineral content, and the overall water hardness may adversely affect customers who, under various seasonal supply scenarios, would be delivered either desalinated water, imported water, or a mixture of both supplies. The CMWD has therefore requested first rights to the desalinated water in order to supply all of its customers from a single source.

If the desalination plant is constructed there will be numerous impacts to the City of Carlsbad and the operation of the CMWD distribution system. In addition to new pipelines, a new pump station will be required at Maerkle Dam to pump desalinated water back into the SDCWA tri-agency pipeline and an additional CMWD pumping facility would be required to supply the upper zones with desalinated water from Maerkle Reservoir. Emergency storage rights for the water in Maerkle Dam will need to be negotiated. The potential impacts of changing the water supply to a desalinated source also need further investigation.

CHAPTER 7
RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Water distribution system improvements are recommended to improve system reliability, increase the available fire flow, replace aging facilities, supply the entire distribution system from Maerkle Dam, and supply projected demands based on build-out conditions. Recommend projects are organized into a phased Capital Improvement Program (CIP). To aid the CMWD in budgeting for capital improvements, this chapter provides estimated construction costs for pipelines, reservoirs, pump stations and miscellaneous improvements.

7.1 RECOMMENDED IMPROVEMENT PROJECTS

The recommended CIP includes the CMWD-funded projects proposed for build-out of the water distribution system, which is projected to occur by the year 2020. The projects are illustrated on Exhibit 3 in Appendix A and summarized briefly below. The major developer-funded projects are also shown on Exhibit 3.

7.1.1 Fire Flow Improvements

Fourteen projects are recommended to increase the available fire flow capacity in the existing system at the locations previously documented in Table 5-3. The majority of the recommended improvements are pipeline replacement projects, specifically the replacement of older 6-inch diameter pipelines with larger diameter pipelines. One of the projects is a new supply connection for fire hydrants along Glasgow Drive, in front of the Calavera recreation facility. Both 446 Zone and 580 Zone pipelines are located in Glasgow Drive, and the existing hydrants are connected to the 580 Zone. The 580 Zone has no storage and, depending on the flow rate ordered form the SDCWA TAP No. 4 Connection, a commercial fire flow may not be available even with the operation of the back-up Calavera Pump Station (capacity = 1,500 gpm). A commercial fire flow rate of 4,000 gpm is available from the 446 Zone pipeline, which is connected to the TAP Reservoir.

Fire flow projects are identified with an "F" label designation on Exhibit 3. It is recommend that the CMWD conduct hydrant flow tests at the locations identified in Table 5-3 to confirm the modeling results before constructing the recommended fire flow projects. As stated previously, the available fire flow is dependent on the exact location, elevation and type of fire hydrant, and also the physical condition (and resulting friction loss) of the upstream pipelines.

7.1.2 Reliability and System Condition Improvements

Six projects are recommend to increase the reliability of the existing system, based on the CMWD requirement that no more than 18 houses are to be served from a dead-end water line. Five of these projects, labeled as CIP project numbers 2, 3, 17, 19 and 24 on Exhibit 3, construct a looped or parallel pipeline to provide redundancy. CIP project 21 constructs a second pressure reducing station (PRS) to supply the 680 Zone. Parallel pipelines are recommended for two fire flow projects (CIP Nos. F12 and F13) to provide redundancy as well as increase the available fire flow. There are three projects recommended to replace existing water mains (CIP Nos. 16, 18 and 26) and several miscellaneous projects, including a new 330 Zone pipeline in Carlsbad Boulevard to provide a two-way emergency interconnect with the SDWD (CIP 22).

7.1.3 Emergency Supply Improvements

Maerkle Dam provides emergency water storage for the CMWD. Several water system improvements are required to supply the entire distribution system from storage in Maerkle Dam. The recommended projects are as follows:

CIP No. 29a – Increase the capacity of the Maerkle Pump Station, which supplies Maerkle Reservoir from the Maerkle Dam. A pumping capacity equal to the average day demand (ADD) of the entire distribution system is recommended. Currently, the Maerkle Pump Station can supply approximately 60 percent of the average day demand. It is noted that ultimate expansion of the Maerkle Pump Station is planned over two phases, designated at projects 29a and 29b in Table 7-1.

CIP Nos. 10 and 11 - Construct a second transmission main from Maerkle Reservoir to the 490 Zone distribution system to increase transmission capacity and provide a redundant supply. A 36-inch diameter pipeline is recommended.

CIP Nos. 6 and 7 - Construct an additional delivery main and PRS to supply the 446 Zone from the 490 Zone.

CIP Nos. 4 and 23 – Construct pipelines to increase the supply capacity from the 490 Zone to the 375 Zone.

CIP No. 5 - Replace the existing 20-inch diameter pipeline in El Camino Real upstream of the Maerkle Control Vault with a 30-inch diameter pipeline and construct a new flow control valve (Maerkle Control Vault). The capacity increase is required to supply the 550 and 700 Zones from the 490 Zone through the Maerkle Control Vault by-pass.

CIP Nos. 15 and 20 - Connect the existing 700N and 700S Zones into a single 700 Zone and construct an emergency pump station to supply the integrated 700 Zone from the 490 Zone. The recommended capacity of this station is 2,500 gpm, which is the projected ultimate ADD of the 700, 680, 580S and 510 Zones.

7.1.4 Capacity Improvements

Several transmission main capacity improvements are recommended in the ultimate distribution system to supply future demands. Generally, distribution pipelines 12-inches in diameter and smaller required to serve future development projects are considered developer-funded projects. Larger pipelines are included in the CIP. In some cases, both the developer and the CMWD will share pipeline project costs.

The supply capacity of the existing SDCWA aqueduct connections is projected to be adequate for ultimate demands. Transmission main capacity improvements are recommended for the 700 Zone to supply future industrial/commercial demands (CIP Nos. 12-14). Other capacity improvements are recommended for the 375 Zone (CIP Nos. 8, 9, 25 and 30) and the 255 Zone (CIP No. 1). A second phase expansion of the Maerkle Pump Station is recommended to supply future demands from Maerkle Dam (No. 29b) and a new PRS will be required when the existing "C" Reservoir is taken out of service (No. 35). There are also several miscellaneous projects identified for future development.

7.1.5 Storage Improvements

Based on projected ultimate demands, there will be a daily storage deficit of approximately 4.5 MG within the distribution system. The storage deficit will increase by an additional 1.5 MG if the CMWD decides to remove the "E" Reservoir from service. It is recommended that the daily storage deficit be met by constructing an additional reservoir at the D3 Reservoir site, where there is already a reservoir pad in place on District-owned property. To operate efficiently in the distribution system, it is recommended that a "twin" reservoir be constructed with the same dimensions and capacity as the existing D3 tank. CIP No. 27 recommends construction of an 8.5 MG "D4" Reservoir.

During completion of this planning document, District Staff decided that the 10-day emergency storage requirement is to be calculated based on the projected ultimate ADD without Phase II recycled water demands. To meet the future emergency storage deficit, construction of an additional reservoir adjacent to Maerkle Dam was recommended in the last Master Plan. This previous storage solution has been carried forward at the request of District Staff, and a buried reservoir with a capacity of 15 MG is recommended to provide the required 10-days of emergency storage at build-out conditions (CIP No. 28).

7.1.6 Water Quality Improvements

Water quality improvements have been tentatively identified for Maerkle Dam, which is the CMWD's largest water storage facility. As discussed in Section 3.8 of this report, CMWD plans to continue the use of chlorine dioxide to maintain water quality in the 195 MG covered reservoir. This results in the need for a permanent installation of a chlorine dioxide generator and chemical storage facility. A decision on the permanent installation will be delayed until after the seawater desalination project has been decided upon, which calls for desalinated water to be stored at Maerkle Dam (refer to Section 6.8). At the direction of CMWD staff, permanent water quality facilities at Maerkle Dam are not included in the CIP.

7.2 BASIS OF CONSTRUCTION COSTS

An opinion of probable construction costs was determined for the CIP projects by multiplying a unit cost for construction by the estimated quantity and adding a 35 percent contingency for engineering, administrative, and legal costs. Pipeline units costs used in the 1997 Master Plan were updated based on the November 2002 Engineering News Record Construction Cost Index (CCI) of 6578. Unit costs were also increased for projects constructed in existing major roadways. No costs are included for land or right-of-way acquisition for transmission and distribution pipelines, as they are typically constructed in the public right-of-way.

7.3 PHASED CAPITAL IMPROVEMENT PROGRAM

A phased CIP has been developed to plan for future water system improvements. The proposed improvements illustrated on Exhibit 3 are itemized with an opinion of probable construction cost and summarized by phase in Table 7-1. The project phases are defined as follows:

> **Phase I – Existing:** Improvements to the existing water distribution system. The majority of the facility improvements are pipeline projects recommended to improve fire flows and meet redundancy criteria. Replacement of older water mains and additional capacity improvements in the vicinity of the D3 Reservoir are also recommended.

> **Phase II – Emergency Supply:** Improvements in this phase consist of facilities required to supply the entire distribution system from Maerkle Dam via the 490 Zone. Included is a new pump station to supply the 700 Zone and capacity improvements at the existing Maerkle Pump Station. Also included are transmission main improvements in the 375 Zone that will be installed with the construction of Cannon Road and College Boulevard, and the transmission main to integrate the 700N and 700S Zones.

Phase III – Future Development: Improvements recommended for the final CIP phase include construction of additional pipelines, pressure reducing stations, and operational and emergency storage facilities. Capacity improvements are recommended that will be constructed with commercial/industrial development in the 700 Zone and the development of Robertson Ranch and LFMZ 25 in the 255 Zone.

These three CIP phases should provide the CMWD with a long range planning tool to keep up with growth and provide for expansion of the water distribution system in an orderly manner. It is noted that phasing for recommended improvement projects may be accelerated or deferred as required to account for changes in development schedules, availability of land or rights-of-way for construction, funding limitations, and other considerations that cannot be predicted at this time.

Table 7-1
CMWD RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Label	Zone	Description/Location	Project Type	Existing Diam.	New Dam.	Pipeline Length	Unit Cost Estimate*	35% Contingency	Total Constr. Cost *	Benefit/Comments
					PHASE I - EXISTING SYSTEM IMPROVEMENTS					
F 1	330	Upsize 6" and 4" PL in Jeanne Place to end of cul-de-sac	Pipeline Replacement	6-in.	8-in.	600'	$95 /linear ft.	$33	$ 76,800	Upsize to provide Residential fire flow
F 2	446	Upsize 6" PL in Nob Hill Drive to end of cul-de-sac	Pipeline Replacement	6-in.	8-in.	650'	$95 /linear ft.	$33	$ 83,200	Upsize to provide Residential fire flow
F 3	446	Upsize 6" PL in Holly Brae Lane and Alder Ave east of Skyline Dr.	Pipeline Replacement	6-in.	8-in.	890'	$95 /linear ft.	$33	$ 114,000	Upsize to provide Residential fire flow
F 4	446	Upsize 6" PL in Falcon Dr. east of Donna Dr. to cul-de-sac	Pipeline Replacement	6-in.	8-in.	870'	$95 /linear ft.	$33	$ 111,400	Upsize to provide Residential fire flow
F 5	255	Upsize 6" PL in Cynthia Ln & Gregory Dr, from Knowles Av to cul-de-sac	Pipeline Replacement	6-in.	8-in.	710'	$95 /linear ft.	$33	$ 90,900	Upsize to provide Residential fire flow
F 6	330	Upsize 6" PL in Tamarack Av from Highland Drive west to Adair St., and in Adair St to cul-de-sac	Pipeline Replacement	6-in.	8-in.	1250'	$95 /linear ft.	$33	$ 160,100	Upsize to provide Residential and Multi-family fire flow
F 7	330	Upsize 6" PL in Highland Dr. from Yourell Ave to Ratcliff	Pipeline Replacement	6-in.	8-in.	700'	$95 /linear ft.	$33	$ 89,600	Upsize to provide Residential fire flow
F 8	580	Switch supply to hydrants at the Calavera Rec. center from the 580 Zone to the 446 Zone	New Connection to Fire Hydrants	NA	NA	NA	$25,000 L.S.	$8,750	$ 33,750	The 580 Zone has no storage. Modify system to provide Comm/Ind fire flow to recreation center from the 446 Zone and TAP Reservoir
F 9	330	Upsize 6" PL from Chestnut Ave at Woodland Way to the end of Woodland	Pipeline Replacement	6-in.	8-in.	560'	$95 /linear ft.	$33	$ 71,700	Upsize to provide Multi-Family fire flow
F 10	255	Upsize 6" PL in Garfield from Chinquapin Ave to end of cul-de-sac	Pipeline Replacement	6-in.	8-in.	846'	$95 /linear ft.	$33	$ 108,300	Upsize to provide Comm/Ind fire flow
F 11	255	Upsize 6" PL in Arland Road from Highland to Buena Vista Way	Pipeline Replacement	6-in.	12-in.	780'	$116 /linear ft.	$41	$ 121,900	Upsize to provide Comm/Ind fire flow
F 12	330	Install parallel pipeline in Highland Dr. from Hillside Dr. south to Adams St.	New Watermain	6-in.	8-in.	2400'	$95 /linear ft.	$33	$ 307,300	Upsize to provide Residential fire flow & provide redundant supply
F 13	255	Install parallel pipeline in Cove Drive from Park Drive to end.	New Watermain	6-in.	10-in.	1300'	$106 /linear ft.	$37	$ 185,700	Upsize to provide Multi-Family fire flow & provide redundant supply
F 14	680	High elevation areas in the vinicity of Obelisco Place/Circle	emergency pump	NA	NA	NA	$75,000 L.S.	$26,250	$ 101,250	Install emergency pump to boost pressures & provide the req'd fire flow @ 20psi
2	255	Parallel existing. 8" PL in Crestview Drive south of El Camino Real	New Watermain	8-in.	8-in.	600'	$95 /linear ft.	$33	$ 76,800	Provides redundant supply to existing residential area
3	255	El Camino Real south from Kelly Drive to Lisa Street	New Watermain	NA	10-in.	1500'	$106 /linear ft.	$37	$ 214,300	Provides looping to improve pressures and reliability
16	550	El Camino Real from Palomar Airport Road south to Cassia Road	Watermain Replacement	20-in.	24-in.	6100'	$240 /linear ft.	$84	$ 1,976,400	Replace existing pipeline and provide increased flow capacity
17	375	Poinsettia Lane west from Skimmer Ct. to Blackrail Rd.	New Watermain	NA	12-in.	4500'	$116 /linear ft.	$41	$ 703,000	Completes 375 Loop along Poinsettia Lane; Increase capacity to/from the D3 Reservoir
18	550	Poinsettia Road, 1100 feet east of Blackrail Rd.	Watermain Replacement	18-in.	30-in.	1100'	$250 /linear ft.	$88	$ 371,300	Increase supply to 550 Zone and D3 Reservoir
19	550	Aviara Pky at Plum Tree north to Mariposa St, then east to Sapphire Dr.	New Watermain	NA	8-in.	3100'	$95 /linear ft.	$33	$ 397,000	Provide redundant supply to residential development
21	680	Intersection of El Fuerte and Corintia St.	New 700 => 680 PRS	NA	NA	NA	$100,000 L.S.	$35,000	$ 135,000	Provide redundant supply to 680, 580S and 510 Zones
22	318	Carlsbad Boulevard from Avenida Encinas south to the District boundary	New Watermain	NA	12-in.	4900'	$116 /linear ft.	$41	$ 765,500	Provide 2-way emergency conn w/SDWD 240 Zone; can supply to 318 Zone west of I-5

Table 7-1 *(continued)*

Label	Zone	Description/Location	Project Type	Existing Diam.	New Dam.	Pipeline Length	Unit Cost Estimate*	35% Contingency	Total Constr. Cost *	Benefit/Comments
PHASE I - EXISTING SYSTEM IMPROVEMENTS *(continued)*										
24	550	Parallel existing PL in Poinsettia Road from Ambrosia Ln. to Blackrail Rd.	New Watermain	18-in & 30-in	12-in.	2000'	$116 /linear ft.	$41	$ 312,400	Provide redundant supply to residential developments
26	700	Palomar Airport Road west of SDCWA Connection #1	Watermain Replacement	20-in.	30-in.	1500'	$250 /linear ft.	$88	$ 506,300	Reduce velocity & provide increased capacity from SDCWA #1 Connection into 700 Zone.
31	490	El Camino crossing at Kelly Dr.	New watermain	NA	12-in.	300	$124 /linear ft.	$43	$ 50,200	Increase supply to the 255 Zone directly from the 490 Zone thru the Kelly PRS
32	NA	Abandonment of 9 wells at the Foussart well field	well abandonment	NA	NA	NA	$150,000 L.S.	$52,500	$ 202,500	Abandon wells per State standards; removal of pumps, structures & restoration of property
33	NA	Lake Calavera Reservoir Improvements	reservoir improvements	NA	NA	NA	$1,200,000 L.S.	$420,000	$ 1,620,000	Replacement of outlet tower valves and piping; Re-grade reservoir bottom
34	255	Oceanside Intertie Upgrade	intertie upgrade	NA	NA	NA	$75,000 L.S.	$26,250	$ 101,250	Valve, pipeline and meter replacements for the existing inter-tie
36	NA	Groundwater/seawater desalination study	report/study	NA	NA	NA	NA	NA	$ 649,860	Investigate treatment/delivery of City owned groundwater;seawater desalination feasibility
								Subtotal Phase I Improvements:	**$ 9,738,000**	
PHASE II - EMERGENCY SUPPLY										
4	375	Bryant Drive from Longfellow to El Camino Real, south on El Camino Real to College and northeast on College to Badger Lane	New Watermain	NA	12-in.	4000'	$116 /linear ft.	$41	$ 624,900	Connects isolated portions of 375 Zone & provides for supply from Maerkle Res. for ex. and future development.
5	490	Upsize existing 20" to 30" along El Camino Real from Cougar Dr. to Faraday Ave including Maerkle Control Valve	Watermain Replacement & valve	20-in.	30-in.	1500'	$250 /linear ft. $150,000 L.S.	$88 $52,500	$ 708,800	Larger diam. pipe reduces pressure loss during emergency supply to 550 Zone from Maerkle Dam
6	490/ 446	College Blvd from Carlsbad Village Drive south to Cannon Road, 490=>446 PRS	New Watermain & PRS	NA	16-in.	6330'	$133 /linear ft. $100,000 L.S.	$47 $35,000	$ 1,273,600	Increase supply capacity to 446 Zone from Maerkle Res.
7	490	College Blvd from future intersection with Cannon south to future Tee leading to Maerkle Reservoir	New Watermain	NA	16-in.	4000'	$133 /linear ft.	$47	$ 719,500	Primary feed for Robertson Ranch (490=>255 PRV); Increase supply capacity from Maerkle
10	490	In College Ave, from Badger Lane north aprrox. 1,200 ft, then east through future development	New Watermain	NA	36-in.	5200'	$220 /linear ft.	$77	$ 1,544,400	Increase supply capacity from Maerkle Res and provide a redundant supply pipeline
11	490	Connection from terminus of Project #10 to Maerkle Reservoir	New Watermain	NA	36-in.	4100'	$220 /linear ft.	$77	$ 1,217,700	Increase supply from Maerkle Res.; Supply to new 490 development east of El Camino and Rancho Carlsbad golf course.
15	700	El Fuerte Street from Palomar Airport Road south to Rancho Pancho	New Watermain	NA	24-in.	5200'	$163 /linear ft.	$57	$ 1,141,000	Connects 700N and 700S Zones; Supply for future development
20	700	Northeast corner of El Camino Real and Palomar Airport Road	Pump Station	NA	Capacity = 2,500 gpm		$900,000 L.S.	$315,000	$ 1,215,000	Provide emergency supply to 700, 680, 580S, and 510 Zones from Maerkle Res; Pump Station sized to supply the projected ult AAD of the zones supplied.
23	375	Cannon Road, 1,800 feet NE from Faraday Road	New Watermain	NA	16-in.	2760'	$133 /linear ft.	$47	$ 496,500	Provide for 375 supply from Maerkle Res; Increased capacity for future development
29 (a)	490	Maerkle Pump Station Capacity Improvements	Enlarge Pump Station	NA	Additional capacity = 5,000 gpm		$500,000 L.S.	$175,000	$ 675,000	Req'd for emergency supply from Maerkle Dam. Increase PS capacity to existing ADD
								Subtotal Phase II Improvements:	**$ 9,616,000**	

Table 7-1 *(continued)*

Label	Zone	Description/Location	Project Type	Existing Diam.	New Dam.	Pipeline Length	Const. Unit Cost	35% Contingency	Total Est. Cost *	Comment
PHASE III - FUTURE DEVELOPMENT										
1	255	From end of Marron Road east to Tamarack; 446=>255 PRV at Tamarack	New Watermain & PRS	NA	12-in.	6600'	$116 /linear ft. $100,000 L.S.	$41 $35,000	$ 1,168,600	Supply new developments in LFMZ 25 & provide additional supply to the 255 Zone
8	375	College Blvd from Cannon Road south to Badger Lane	New Watermain	NA	12-in.	4130'	$116 /linear ft.	$41	$ 645,200	Supply for new development and creates 375 Zone loop east of El Camino
9	375	In Cannon Rd., from Merwin Drive east to intersection with future College Blvd.	New Watermain	NA	12-in.	4400'	$116 /linear ft.	$41	$ 687,400	Supply for new development and creates 375 Zone loop east of El Camino
12	700	In future extension of Melrose Dr., from PAR north to future Faraday Rd.	New Watermain	NA	16-in.	4000'	$133 /linear ft.	$47	$ 719,500	Provides looped supply to new North 700 zone business park in LFMZ 16 (1 of 3)
13	700	In northern El Fuerte St. extension, to future Faraday Road	New Watermain	NA	16-in.	2200'	$133 /linear ft.	$47	$ 395,700	Provides looped supply to new North 700 zone business park in LFMZ 16 (2 of 3)
14	700	In future Faraday Rd. extension, between El Fuerte St. and Melrose Dr.	New Watermain	NA	16-in.	3600'	$133 /linear ft.	$47	$ 647,600	Provides looped supply to LFMZ 16 (3 of 3) and supply to 550 Zone from 700=>550 PRV
25	375	Poinsettia Road from El Camino Real west to Skimmer Court (Poinsettia Lane)	New Watermain	NA	12-in.	1300'	$116 /linear ft.	$41	$ 203,100	Parallel existing 8-inch to increase capacity in the 375 Zone and supply from the 550 Zone thru Villages of La Costa
27	375	Construct new 375 Zone water reservoir next to existing D-3 Reservoir	New Water Storage Reservoir	NA	Capacity = 8.5 MG		$0.60/ gal	$0.21/ gal	$ 6,885,000	Provides additional daily storage within the distribution system for ultimate demands
28	490	Construct buried storage reservoir next to existing Maerkle Reservoir	New Water Storage Reservoir	NA	Capacity = 15 MG		$1.00/ gal	$0.35/ gal	$ 11,475,000	Provides additional emergency storage to meet 10-day storage criteria based on ultimate demands
29(b)	490	Maerkle Pump Station Capacity Improvements	Enlarge Pump Station	NA	Additional capacity = 5,000 gpm		$500,000 L.S.	$175,000	$ 675,000	Req'd for emergency supply from Maerkle Dam. Increase PS capacity to projected ADD
30	375	Gross Pressure Reducing Station Improvements	490=>375 PRS Upgrade	NA	NA	NA	$75,000 L.S.	$26,250	$ 101,250	Increase capacity of existing Gross PRS to supply new development from 490 Zone
35	392	Install 490=>392 PRS at Cannon Road and College Blvd.	490=>392 PRS	NA	NA	NA	$100,000 L.S.	$35,000	$ 135,000	Project will take place when existing "C" Reservoir is taken out of service
37	580	Calavera Pump Station Improvements, College Blvd at Carlsbad Village Dr.	PS upgrades	NA	NA	NA	$300,000 L.S.	$105,000	$ 405,000	Install standby generator & building, hydropneumatic tank & add'l pump
							Subtotal Phase III Improvements:		**$24,143,000**	
			CIP TOTAL PHASES I - III						**$43,497,000**	

* Opinion of probable construction cost is based on a Construction Cost Index (CCI) of 6578 for November 2002.

CHAPTER 8
WATER CONNECTION FEE UPDATE

The CMWD has historically charged connection fees to provide water service to its new customers. The fees pay for the planning, design and construction of capacity improvements and/or new facilities required for the delivery, distribution and storage of water. Under California State law, connection fees must be based on relevant capital costs. This chapter provides an updated basis for new potable water connection fees based on current growth projections and capital improvement projects identified to serve future development. A cash flow analysis is performed with the updated connection fee from a starting date of October 1, 2003 through buildout, which is projected to occur by 2020.

8.1 BACKGROUND

Water connection fees are used to generate revenue to construct water infrastructure needed to support new development. Assembly Bill 1600 was incorporated into the California Government Code under Title 7, Division 1, Chapter 5: "Fees for Development Projects", effective 1989. Chapter 5 states that any fee imposed by a local agency, such as the CMWD, must show that the fee will be used only for purposes related to the service for which the fee is assessed. The law requires that the CMWD: 1) identify the purpose of the fee, 2) identify the use for which the fee is to be put, 3) show a relationship between the fee's use and the type of development project on which the fee is imposed, and 4) show a relationship between the need for the facility and the type of development project on which the fee is imposed. This chapter provides the basis for connection fees needed to satisfy California law.

The water connection fee was developed as part of the 1990 Water Master Plan and calculated based on equivalent dwelling units (EDUs). EDU conversions are defined in the Carlsbad Municipal Code for purposes of estimating wastewater flows, but are not necessarily representative of water demands. In January 1996 the *Water and Wastewater Rate Study and Financial Plan* recommended changing to a simple, equitable method of assessing water connection fees based on the water meter size. The transfer of methods was initially made by assuming that one EDU is equivalent to the water use from a 5/8-inch meter, which is the typical meter size supplied for a single-family dwelling.

The connection fee varies depending on the hydraulic capacity of the meter and the potential demand it could place on the water system. The current water connection fee is $2,400 for a 5/8-inch meter connection. Charges for other meter sizes are shown in Table 8-1. Charges for larger meters are based on a "modified" capacity ratio, which was developed in the 1996 Rate Study. The fees for turbine and turbo meters are proportionally higher based on their higher flow capacity.

Table 8-1
CMWD EXISTING CONNECTION FEES

Meter Size (inch)	Meter Type	Connection Fee	5/8" Meter Fee Ratio
5/8"	Displacement	$2,400	1
3/4"	Displacement	$3,420	1.43
1"	Displacement	$5,400	2.25
1.5"	Displacement	$10,200	4.25
	Turbine	$11,975	5
2"	Displacement	$15,360	6.4
	Turbine	$19,200	8
3"	Displacement	$27,000	11.25
	Turbine	$42,000	17.5
4"	Displacement	$42,000	17.5
	Turbine	$72,000	30
	Turbo	$120,000	50
6"	Displacement	$78,000	32.5
	Turbine	$150,000	62.5
	Turbo	$240,000	100

The connection fees in Table 8-1 are currently charged for new connections to both the potable and recycled water systems. In addition to the CMWD connection fee, there is also a County Water Authority connection fee that is imposed on potable water connections, but not connections to the recycled water system. It is noted that the connection fee update analysis presented in this chapter is based on future connections and improvement projects for the potable water system. The updated fee is therefore applicable to meters supplied from the potable water system only.

8.2 GROWTH PROJECTIONS

The total number of future users and an estimate of the number of corresponding water meters must be projected to calculate connection fees. The City of Carlsbad Growth Database is used in this Master Plan Update to determine the number of future users and project the ultimate water demand for the analysis of the water distribution system (documented in Chapter 6, Section 6.1). Parcels in the Growth Database are assigned to one of 25 Local Facility Management Zones (LFMZ), as illustrated previously on Figure 6-1. For the connection fee update, an updated version of the Growth Database is used to determine the number of future users. In the updated Growth Database, future users are based on development that is projected to occur after October 1, 2003.

Growth data in the updated Growth Database consists of the number of projected residential units and the estimated building area for non-residential parcels at build-out. To estimate the number of future water meters, the projected residential units were identified as either single or multi-family (apartment) units.

In the CMWD, single–family residences are connected with 5/8-inch water meters. Future single-family residential units are therefore assigned one "meter EDU" based on a 5/8-inch water meter. Multi-family and non-residential parcels are served from larger meters, and water meter EDU conversion factors are developed for these development types in the following report section.

8.3 WATER METER EDU CONVERSIONS

The number of future water meters must be projected to calculate an updated water connection fee. Future single-family residential units are assigned one "meter EDU" based on a 5/8-inch water meter. Multi-family and non-residential parcels, however, are typically served from multiple and larger-sized meters. The required size and number of meters to supply these parcels are based on calculations which take into account the specific building type, fixture counts, and peaking formulas. Since this detailed information is not available in the Growth Database, a method of estimating of the number and size of future multi-family and commercial meters to project the number of future meter EDUs needs to be developed.

The CMWD identifies 12 categories of meter types for billing purposes. The meter account categories are: single-family, duplex, multi-family, multi-family public dwelling units, commercial, institutional, agriculture (3 specific types), irrigation, fire protection, and temporary (construction water). Multi-family and commercial/industrial parcels typically have separate meters for landscape irrigation and fire protection. Connection fees are not charged for fire protection meters, and it is assumed that future irrigation demands will be supplied from the recycled water system. The number of water meter EDUs for future multi-family and non-residential development will therefore be based on the projected number of multi-family and commercial account type meters only.

8.3.1 Multi-Family Meter EDUs

Water demands for future multi-family units are estimated in this Master Plan Update based on a projected water use of 250 gallons per day per unit, or an EDU of 0.45. An EDU based on demand, however, does not necessarily equate to a "meter EDU" based on a 5/8-inch water meter. A 451-unit apartment complex currently under construction in the Kelly Ranch development is considered to be typical of future multi-family developments. Twenty-six 2-inch multi-family water meters have been purchased to serve this development. Based on the fee structure in Table 8-1, each 2-inch meter is charged a rate 6.4 times higher than a 5/8-inch meter. This results in a meter EDU of 0.37 for each multi-family unit (26 meters x 6.4 EDUs per meter / 451 units). Based on this data, each multi-family unit in the growth database will be assigned a meter EDU of 0.4. Stated another way, the water connection fee for approximately 2.5 multi-family units is projected to be the same as the connection fee for a single-family unit.

8.3.2 Non-Residential Meter EDUs

An analysis of existing commercial water meter data was performed to determine the relationship between non-residential building area and water meter size. The building area associated with each existing commercial meter was estimated from parcel data assuming a building coverage of 25 percent, which is the assumption used in the City's Growth Database when specific information on building size is unavailable. For parcels with multiple commercial water meters, the parcel size was apportioned based on meter size and quantity. Table 8-2 summarizes the existing commercial water meter data and calculates the average building size for various meter sizes. A meter conversion factor is then calculated to determine the number of equivalent 5/8" meters. The majority of future commercial meters are anticipated to be 1, 1-1/2, or 2-inch meters. A single conversion factor was therefore calculated based on a weighted factor for these meter sizes. This conversion factor can be used to project the number of future meter EDUs from the future industrial and commercial building area in the Growth Database.

Table 8-2
ANALYSIS SUMMARY OF EXISTING COMMERCIAL METERS

EXISTING COMMERCIAL METERS				Existing 5/8" Meter Fee Ratio	5/8" Meter conversion Factor$^{(3)}$
Meter Size	No. of Meters	Average Parcel Size$^{(1)}$	Estimated Building Size$^{(2)}$		
5/8"	176	10,316 sqft	2,579 sqft	1	2,579
3/4"	47	41,475 sqft	10,369 sqft	1.43	7,276
1"	**94**	**72,991 sqft**	**18,248 sqft**	**2.25**	**8,110**
1.5"	**137**	**102,235 sqft**	**25,559 sqft**	**4.25**	**6,014**
2"	**295**	**127,742 sqft**	**31,935 sqft**	**6.40**	**4,990**
3"	4	165,843 sqft	41,461 sqft	11.25	3,685
Weighted Average based on 1", 1-1/2" & 2" meters:					**5,810**

(1) For parcels with more than one meter, parcel size is proportioned to individual meters.
(2) Building size is calculated at 25% of the parcel size, which is the assumption used in the City's Growth Database for non-residential land use.
(3) Building area is divided by this conversion factor to obtain the number of 5/8" meter EDUs

8.4 PROJECTED WATER METER EDUs

The projected future development within the CMWD Service Area after October 1, 2003 is summarized in Table 8-3 by LFMZ. Also shown in this table is the projected meter EDUs based on a 5/8-inch water meter, which is the basis of the water connection fee update.

Table 8-3
FUTURE POTABLE WATER METER EDUs

LFMZ	Future Development			5/8" Meter EDUs*	LFMZ	Future			5/8" Meter EDUs*
	Residential		Non-Residential			Residential		Non-Residential	
	SF Units	MF Units	Building Area (sqft)			SF Units	MF Units	Building Area (sqft)	
1	290	399	1,016,581	625	14	608	352	0	749
2	22	118	39,656	76	15	470	80	275,000	549
3	12	0	148,551	38	16	0	0	1,413,522	243
4	40	0	0	40	17	598	0	2,438,000	1,018
5	0	0	2,496,687	430	18	0	0	2,226,000	383
6	128	0	180,065	159	19	84	0	223,637	122
7	268	437	30,000	448	20	497	0	70,750	509
8	170	86	6,000	205	21	180	212	0	265
9	1	0	411,500	72	22	222	0	84,780	237
10	740	315	0	866	24	30	0	0	30
13	0	0	1,309,692	225	25	130	0	0	130
Totals:	**6,489 residential units**			**12,370,421 sqft of building area**					**7,419 EDUs**

* Water Meter EDU conversions based on: 1 SF unit = 1 meter EDU
2.5 MF units = 1 meter EDU
5,810 sqft Non-Residential area = 1 meter EDU

8.5 CAPITAL COSTS

The basis of capital cost estimates for the water connection fee is the Capital Improvement Program (CIP) previously identified in Table 7-1 of this Master Plan Update. The CIP lists current and future projects that will be needed to support the build-out population, including replacement of existing facilities and maintenance–related projects. However, only those projects related to growth are included in the connection fee calculations. The potable water capital improvement projects and estimate of probable costs for the connection fee update are summarized in Table 8-4.

8.6 CONNECTION FEE CALCULATIONS

The water meter connection costs for potable water service can be determined from the CIP costs and the projected number of future meter EDUs. Because the actual number of units eventually constructed may vary, it is prudent to reduce the estimate of future water EDUs in the calculation of connection fees. This unit reduction, or "safety factor", ensures that the necessary fees will be collected even if areas within the CMWD are not completely buildout as planned.

As stated previously in Section 8.3, future irrigation meters are assumed to be connected to the recycled water system, and are therefore not considered in the future meter EDU projections. However, it is acknowledged that some irrigation meters will be connected to the future potable water system, at least

Table 8-4
CAPITAL IMPROVEMENT PROJECTS FOR THE WATER CONNECTION FEE UPDATE

CIP NO.	MASTER PLAN PROJECT DESCRIPTION/LOCATION	PROJECT TYPE	ESTIMATED COST	FUTURE YEAR BUDGET AMOUNTS						
				YEAR 1 2003-2004	YEAR 2 2004-2005	YEAR 3 2005-2006	YEAR 4 2006-2007	YEAR 5 2007-2008	YEAR 6-10 2008-2013	BUILDOUT 2013+
1	From end of Marron Road east to Tamarack; 446=>255 PRV at Tamarack	New Watermain & PRS	$ 618,000*						$ 618,000	
3	El Camino Real south from Kelly Drive to Lisa St.	New Watermain	$ 164,300*			$ 164,300				
4	Bryant Dr. from Longfellow to El Camino Real, south on El Camino Real to College & northeast on College to Badger Ln	New Watermain	$ 624,900					$ 624,900		
7	College Blvd from future intersection with Cannon south to future Tee leading to Maerkle Res.	New Watermain	$ 421,000*			$ 421,000				
8	College Blvd from Cannon Road south to Badger Lane	New Watermain	$ 645,200	$ 645,200						
9	In Cannon Rd., from Merwin Drive east to intersection with future College Blvd.	New Watermain	$ 687,400	$ 687,400						
12	In future extension of Melrose Dr., from PAR north to future Faraday Rd.	New Watermain	$ 719,500	$ 719,500						
13	In northern El Fuerte St. extension to future Faraday Av	New Watermain	$ 148,800*	$ 148,800						
14	In future Faraday Rd. extension, between El Fuerte St. and Melrose Dr.	New Watermain	$ 647,600	$ 647,600						
15	El Fuerte St. from Palomar Airport Rd south to Rancho Pancho	New Watermain	$ 1,141,000	$1,141,000						
17	Poinsettia Ln west from Skimmer Ct. to Blackrail Rd	New Watermain	$ 309,000*	$ 309,000						
18	Poinsettia Road, 1100 feet east of Blackrail Rd.	Watermain Upgrade	$ 185,700*			$ 185,700				
20	Northeast corner of El Camino Real and Palomar Airport Road	Pump Station	$ 1,215,000			$1,215,000				
25	Poinsettia Road from El Camino Real west to Skimmer Court (Poinsettia Lane)	New Watermain	$ 203,100	$ 203,100						
27	Construct new 375 Zone water reservoir next to existing D-3 Reservoir	New Water Storage Reservoir	$ 5,163,800*						$ 5,163,800	
28	Construct buried storage reservoir next to existing Maerkle Reservoir	New Water Storage Reservoir	$11,475,000						$11,475,000	
29(b)	Maerkle Pump Station Capacity Improvements	Enlarge Pump Sta.	$ 675,000					$ 675,000		
31	El Camino Crossing at Kelley Dr.	New Watermain	$ 94,000			$ 94,000				
30	Gross Pressure Reducing Station Improvements	490=>375 PRS Upgrade	$ 101,300					$ 101,300		
37	Calavera Pump Station Improvements, College Blvd at Carlsbad Village Dr.	PS upgrades	$ 405,000		$ 81,000	$ 324,000				
--	Master Plan Upate and CEQA documentation	Prepare Report	$ 43,200*						$ 43,200	
	Total Cost for Connection Fee Projects:		**$25,687,800**	**$4,501,600**	**$81,000**	**$2,404,000**	**$0**	**$1,401,200**	**$17,300,000**	**$0**

* Opinion of probable cost for the Connection Fee is less than the total project cost due to other funding sources or prior expenditures for this project.

Initially, and water connection fees will be collected for these meters. A review of water meters issued over the past three years indicates that irrigation meters connected to the potable water system accounted for approximately ten percent of the total meter EDUs issued. Since this trend is likely to continue, the additional fees collected from future potable water irrigation meters can be considered a “safety factor” in the event the CMWD is not fully built out as planned. The number of projected meter EDUs calculated in Table 8-3 is therefore used without any percentage reduction to calculate connection fees.

The calculations for the updated connection fee are shown in Table 8-5. The “Total Cost” in Table 8-5 is the capital budget minus the available cash balance in the water connection fee account. City staff have projected the available cash balance on October 1, 2003 to be $3,440,669. The new connection fee is calculated to be $2,999 for a 5/8-inch meter. Table 8-6 lists the cost for other water meter sizes utilizing the current fee ratio, which was developed in the 1996 Rate Study based on a modified capacity ratio. The updated connection fees apply to meters connected to the potable water system only.

Table 8-5
WATER CONNECTION FEE CALCULATION

Capital Budget	Available Cash Balance	Total Cost	Future Meter EDUs	Cost Per Meter EDU (5/8" meter)
$25,687,800	$3,440,669	$22,247,131	7,419	$2,999

Table 8-6
UPDATED CONNECTION FEES

Meter Size (inch)	Meter Type	Updated Connection Fee
5/8"	Displacement	$2,999
3/4"	Displacement	$4,274
1"	Displacement	$6,748
1.5"	Displacement	$12,746
	Turbine	$14,964
2"	Displacement	$19,194
	Turbine	$23,992
3"	Displacement	$33,739
	Turbine	$52,483
4"	Displacement	$52,483
	Turbine	$89,970
	Turbo	$149,950
6"	Displacement	$97,468
	Turbine	$187,438
	Turbo	$299,900

8.7 WATER SYSTEM CASH FLOW ANALYSIS

A cash flow table can be constructed using the water connection fee calculated in Table 8-5, yearly buildout projections based on the City of Carlsbad Growth Database, and project phasing estimates provided by City Staff. Table 8-7 provides a water cash flow table using the calculated connection fee over a seventeen-year period, starting in October 1, 2003 and ending at 2020, which is the projected buildout year for the City. At the end of the chosen time period the cumulative balance is $0, because the connection fees are based on a budget that includes the available cash balance. It is noted that all values used in the cash flow tables are in current dollars.

Table 8-7
WATER CONNECTION FEE CASH FLOW ANALYSIS

Fiscal Year	New EDUs	Connection Fee	Revenue	CIP Costs	Balance	Cumulative Balance
					Available cash balance projected for 10/1/03 =	$3,440,669
2003	480	$2,999	$ 1,439,361	$ 4,501,600	$ (3,062,239)	$ 378,430
2004	907	$2,999	$ 2,719,793	$ 81,000	$ 2,638,793	$ 3,017,224
2005	704	$2,999	$ 2,111,064	$ 2,404,000	$ (292,936)	$ 2,724,287
2006	833	$2,999	$ 2,497,892	$ -	$ 2,497,892	$ 5,222,179
2007	568	$2,999	$ 1,703,244	$ 1,401,200	$ 302,044	$ 5,524,224
2008	585	$2,999	$ 1,754,222	$ 3,460,000	$ (1,705,778)	$ 3,818,446
2009	554	$2,999	$ 1,661,263	$ 3,460,000	$ (1,798,737)	$ 2,019,709
2010	474	$2,999	$ 1,421,369	$ 3,460,000	$ (2,038,631)	$ (18,922)
2011	432	$2,999	$ 1,295,425	$ 3,460,000	$ (2,164,575)	$ (2,183,497)
2012	374	$2,999	$ 1,121,503	$ 3,460,000	$ (2,338,497)	$ (4,521,994)
2013	316	$2,999	$ 947,580	$ -	$ 947,580	$ (3,574,414)
2014	288	$2,999	$ 863,617	$ -	$ 863,617	$ (2,710,797)
2015	187	$2,999	$ 560,751	$ -	$ 560,751	$ (2,150,046)
2016	158	$2,999	$ 473,790	$ -	$ 473,790	$ (1,676,256)
2017	139	$2,999	$ 416,815	$ -	$ 416,815	$ (1,259,441)
2018	131	$2,999	$ 392,826	$ -	$ 392,826	$ (866,616)
2019	152	$2,999	$ 455,798	$ -	$ 455,798	$ (410,818)
2020	137	$2,999	$ 410,818	$ -	$ 410,818	$0
Totals:	**7,419**		**$ 22,247,131**	**$ 25,687,800**	**$ (3,440,669)**	